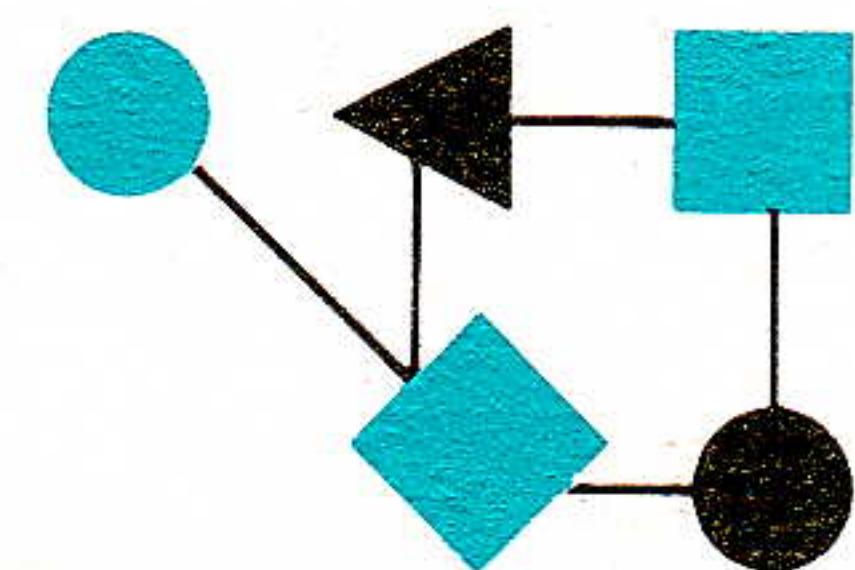


CONNEXIONS



The Interoperability Report

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*ConneXions —
The Interoperability Report
tracks current and emerging
standards and technologies
within the computer and
communications industry.*

In this issue:

Enterprise Networking and National ISDN Synergy.....	2
CORBA.....	18
TRnet: A possible future use of the Internet.....	25
Announcements.....	28

From the Editor

I've just returned from Paris and the last official INTEROP! The show attracted over 23,000 visitors from all over Europe. Next year, the event will be called *NetWorld+ Interop*. There will be a total of 5 events, two in the US, two in Europe and one in Japan. Network computing and interoperability are topics of global concern as witnessed by the tremendous growth in the industry and the growth of the Internet which recently topped over 2 million connected hosts.

Two patterns emerge as I look back at 1993. First, *Asynchronous Transfer Mode* (ATM) became the major "hot topic" in all sectors of the networking industry. Many ATM product announcements and a great deal of promises were made during the year, and much more is yet to come. Second, the Internet engineering community agreed that "something must be done" in order to solve the limitations imposed by the 32-bit IP address structure. Efforts are now underway to bring us the "IP Next Generation" (IPng). At the same time, the Internet has not been using the existing address space in the most efficient manner, so allocation of new addresses is now done with *conservation* in mind, while we wait for IPng.

The IPng effort deserves a special issue of *ConneXions*, and we hope to bring you such an edition sometime in the spring of 1994. We also have articles on the SNMP RMON standard, ST-II for multimedia, and mobile networking. There is much more "in the pipe," so make sure your subscription stays current.

But back to 1993. Our final issue of the year features an article on National ISDN and Enterprise Networking. ISDN has been slow to gain acceptance in the US, but as Joe Hobbs of Bellcore explains, a strong synergy exists between Enterprise Networks and ISDN, and we should begin to see results of this synergy in the next 2-3 years.

The *Object Management Group* (OMG) is an international industry consortium whose mission is to define a set of interfaces for interoperable software using an object-oriented approach. Their first specification, CORBA, defines a higher level facility for distributed computing, as outlined here by Tom Mowbray and Ron Zahavi of the MITRE Corporation.

Billy Barron describes the TeleRead/TRnet proposal which aims to put electronic books in the hands of the general public and use the Internet as the underlying communications infrastructure.

With that, it is time to wish you a peaceful holiday and welcome you back to Volume 8 in a few weeks.

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Enterprise Networking & National ISDN Synergy

by Joseph J. Hobbs, Bellcore Training & Education Center

Introduction

This article will establish the premise that a strong synergy exists between Enterprise Networks and National *Integrated Services Digital Networks* (ISDN) to the extent that each will benefit from the other, therefore refuting the argument that the deployment of ISDN (in the form of National ISDN) is "too late." The article will present a general application and technology profile of the near-term Enterprise Network needs for each of the years 1993, 1994, and 1995 of a transition period that will continue into the next century. Next, this article will establish a general applications and technology profile that should be available from NI-1 deployment during 1993, from NI-2 deployment during 1994, and from NI-3 during 1995. The application needs of the Enterprise Networks will, or will not, match up with the application capabilities of National ISDN during each of the three years 1993, 1994, and 1995. This very direct "application needs/solution" comparison will either support or refute, the premise that "synergy does exist between ENs and NI."

EN and NI

Enterprise Networking (EN) is the term used to define the global information transfer of voice and data signals of the typical mid-size to large business. The EN will support all applications such as transaction processing of all types, LAN interconnection, file transfer, electronic mail, fax, and others, with a consistent infrastructure. *National ISDN* (NI) is the latest deployment strategy for a digital, multi-channel architecture promising to integrate voice and data at the desktop over a limited set of standardized interfaces. Both EN and NI will be with us through the mid-nineties, and, perhaps, into the early twenty-first century.

EN and NI structure

ENs are rapidly evolving in terms of structure and applications. "We don't have to move people anymore—we just move signals. These are the super highways of the 21st century" was a quote from the *Wall Street Journal*, September 13, 1991.

Today's ENs are on fast track towards many new frontiers. Portia Isaacson defined the *Information Technology* (IT) Platform 2002 for CIO Magazine in their July, 1992 issue. IT is expected to be in widespread use to support people in the creation, delivery, and "exchange of value" in products, services, and currency with customers. Businesses will have evolved from the industrial, mass-production era into an information form. Businesses will spend more money on *Mobile Computers* (MCs) and MC communications services than they do on all other forms of computing and communications combined. MCs will be the design center of enterprise information systems. Desktop base stations will serve for phone, fax, and wired LAN hubs.

Isaacson also expects that mainframe/midrange systems and LAN servers will be transparent information warehouses, secondary to personal base stations in the IT architectural significance. Wired and wireless technologies will create global, regional and local webs of data paths that will be dynamically chosen based on availability and economics for a specific task. Optical character recognition and voice recognition will be common encoding methods. Peer-to-peer networks will be in.

People-to-people communication will dominate connectivity issues. Servers and base stations will facilitate client-to-client communication and act as repositories for workgroups, enterprises, industry groups and families.

Desktop base stations, MCs and consumer electronics will share a common media and expansion standard in a PC. Collaborative IT will be wireless MC-to-MC with simultaneous voice and fax. Editable forms of images as well as integrated voice will be adopted as advanced fax standards. From these projections into the future, it is safe to expect EN applications and technologies to go through dramatic transitions.

National ISDN (NI) is a standard ISDN implementation agreement that is guiding the current, aggressive deployment by the Local Exchange Carriers in the USA. The NI agreements have been established through concerted efforts and cooperation by the "who's who" of the telecommunications industry through the structure created by the *North American ISDN Users' Forum* (NIUF), and contributions by the *Corporation for Open Systems International* (COS) with the *National Institute of Standards and Technology* (NIST) serving as chair and hosting the NIUF secretariat. NI deployment will begin with an implementation agreement referred to as National ISDN-1 (NI-1) [1], and continue with National ISDN-2 (NI-2) [2] and National ISDN-3 (NI-3) [3]. NI, similar to the ENs, will be evolving into the future with more features and functionality each step along the way.

Trends

This section will establish a general application and technology profile of the Enterprise Network needs for each of the years 1993, 1994, and 1995. Up until the early 1990s, voice and data networks had evolved from predominantly analog to predominantly digital, at the same time they became integrated instead of separate. Data and voice applications became integrated into high speed, digital backbone trunks using sophisticated multiplexers. Along with this integration came a high level of user control over channelization and bandwidth assignments. [4]

During the mid-nineties, this trend will continue with deployment of more raw bandwidth, more transmission schemes, and more transport technologies. These changes in networking are occurring because of the changes in the way businesses work today. Competitive pressures require ENs to provide cross-functional communication to support the needs of the business. In fact, supplier-buyer relationships require ENs to interface with other ENs for certain applications such as inventory, billing, and invoicing for example.

Within this enormously complex relationship of computing resources, networking protocols, and applications programs, virtually all of the information transfer can be segmented into the four basic areas of *applications, access, switching, and trunking*.

The importance of the end user, and the applications that justify the ENs in the first place, are often overlooked in the rush to discover the panacea technology. In reality, there is no such thing as a single technology, nor even a single architecture that can satisfy the applications, access, switching, and trunking diversity of the typical EN.

"Too often networks are likened to highways...This comparison is misleading because it suggests the network can stand by itself. That is not the case. The added intelligence at each node and at the ends of the network are what make the system work." —Nicholas Negroponte

As we will see in the next section, there is so much diversity within the ENs that one of the major concerns of any network administrator is deciding how to control and manage it all.

Today's Enterprise Networks

Enterprise Networking & National ISDN (*continued*)

The voice and data telecommunications environment of a "typical" mid-sized to large business enterprise is a complex assemblage of applications software, physical devices, transmission protocols, and transport media. The financial survival of the firm typically depends on the efficiency of these components. The firms which best match the needs of their business with the best technological solutions will be the most competitive.

The entire telecommunications requirements of the enterprise will continue, for the foreseeable future, to be an accumulation of "real world" implementations of PBXs, Key systems, LANs, Gateways, Bridges, Routers, MANs, WANs, Packet Switches, PADs, CSUs, DSUs, FEPs, Applications Software, T1 Muxes, Dumb Terminals, communications software, protocols, dial-up lines, modems, leased lines, Personal Computers, and other examples of telecommunications technologies that have been available over the last ten to fifteen years.

Applications

- Multimedia applications (9)
- Internetworking E-mail Enabled Applications (7)
- Videoconferencing Growth (8)

Architecture, Access, Topology

- Client-server computing growth (5)
- High bandwidth via copper (10)
- Consolidation at the hub (3)
- Multivendor Multiprotocol internetworks (4)

WAN Interconnectivity

- Bandwidth on demand (1)
- ATM in private networks (2)

Management

- Automatic Network Management (6)

Communications Week, July 27, 1992

Figure 1: Top Ten Hottest User Trends Through 1995

Each of these Enterprise-Wide Networks is in the process of transitioning out the older technologies and implementing the newer, more cost-effective technologies. According to a November 1992 *Communications Week* Managers Survey, Novell Inc.'s *NetWare* is the leading standard for LANs and TCP/IP was chosen as the favorite WAN standard. Among the newer technologies considered most important to their networking strategy were *Asynchronous Transfer Mode* (ATM) and *Fiber Distributed Data Interface* (FDDI). (Much of the new technology can also be conveniently segmented into the areas of access, switching and trunking.)

The ENs are based on technology standards from several sources including IEEE, OSI, CCITT, ANSI, COS, T1, FIPS, and vendor proprietary *de facto* standards. The predominant LAN standards are from the IEEE and define Ethernet (802.3), Token Bus (802.4), Token Ring (802.5), Logical Link Control (802.2), and also include implementations of the ANSI-FDDI standard. MAN implementations will be comprised of ANSI-FDDI and the IEEE 802.5 standard for Switched Multimegabit Data Service (SMDS). WAN technologies and standards will include Frame Relay, X.25, HDLC, SDLC, SONET, ATM, Cell Relay, ISDN, SS7, Broadband ISDN, and Advanced Intelligent Network applications.

Transfer of traffic between the EN components is accomplished with protocols and standards such as SAA/SNA/ APPC/APPN and the OSI Communication Subsystem for transaction processing, TCP/IP for LAN traffic, and OSI GOSIP standards such as X.400 and X.500 for messages of mixed formats. [5]

As the new technology is deployed, new applications must be supported such as LAN interconnection, desktop integration of voice and data, and video teleconferencing. Many existing applications will continue to be supported by a blend of old and new technologies. Enterprise Networks will be under continued pressure to support the elusive combination of interoperability, management, throughput, and cost. EN mainstream applications and traffic characteristics can be identified and categorized for the current year, and can be very accurately anticipated for the years through to 1996.

Selected applications

Enterprise Network trends are driving the need for higher speed LAN, MAN, WAN, and *Global Area Networks* (GANs). During the early 1990s, both public and private switched services will be used to achieve multinode hybrid connections, and static bandwidth multiplexers will give way to a more flexible allocation of bandwidth using frame relay and cell relay/cell switching over node-to-node trunks. [6] Some additional significant trends are; growth in imaging applications, shifts to multimedia integration, mail-enabled and groupware applications.

The problems as of 1989 were: [7]

- 324 billion documents handled by U.S. businesses at 25 cents per document
- \$81 billion annually
- 1% stored electronically
- 4% on microfiche
- 95% on paper only

Imaging

These enormous problems create an outstanding opportunity for applying technology to completely redefine associated workflows rather than just mechanizing the processes. Image management software can simplify and automate these multistep, multidepartmental interactions. More than 90% of the Fortune 1000 companies were planning to install or upgrade imaging systems during 1992 with the major application area being workflow automation. [8]

Imaging applications can extend through medical records, X-rays, CAT scans, insurance forms, claims processing, airline tickets, freight bills, invoices, fax, OCR, legal documents, municipal records, and numerous other examples. The benefits derived from implementation of the imaging systems are:

- Improved document/imaging access
- Space savings
- Reduced paper use
- Better file organization
- Paper file backup/archive
- Other misc. productivity improvements

Over time, stand alone imaging applications will disappear in favor of the integration and interworking of Multimedia video, audio, and image.

Enterprise Networking & National ISDN (*continued*)

Per the International Teleconferencing Association, this market is growing at 30% per year and will represent \$1.5 billion by 1995. By 1994, there will be a pronounced shift to desktop multimedia video conferencing. [9] (A later section of this article will deal specifically with the networking of these applications at 64Kbps, or in increments of " $n \times 64$ " bandwidth segments, in accordance with the new CCITT H.261 Video Encoding standard adopted in 1992.)

E-mail

Mail-enabled applications will experience a tenfold increase from 1990 to 1995. [10] E-mail, fax, and voicemail applications are becoming nearly as common as the telephone today with over 13.5 million mailboxes expected by 1993. These systems will be implemented on mainframe and midrange computers, and LAN-based processors. Expectations are high, but cost effective integration technologies, industry acceptance of X.400/X.500 standards, and availability of adequate bandwidth (64Kbps and up) at the desktop are critical success factors for these applications.

Groupware

The groupware applications market will grow to about \$600 million by 1995 according to the International Data Corporation. Groupware provides support for personal data interaction in a conversational mode from multiple sources. "New network software lets brainstormers around a table all 'talk' at once on their keyboards. The result: measurable productivity gains from desktop computing." [11] One vendor's implementation provides functionality in areas such as:

- Correspondence processing with full support for compound documents with attributes of text, graphics, and images,
- Integrated computer conferencing, broadcast dissemination and mail-enabled applications,
- Full searchable document databases with customization options for alternative organization and presentation of documents,
- Mail, including name, address books and user-defined filters for selecting, copying, and deleting messages,
- Imports and exports for spreadsheets, word processing files and standard graphics/image formats.

These implementations involve paradigm shifts from information processing to information sharing; and from messaging to partnering. [12] Groupware applications support mail-enabled transmissions, workflow management, collaborative computing, and office automation activity.

Top 17

A number of key EN applications recently came from the North American ISDN User Forum (NIUF) in a prioritized list represented as their "Top 17":

- | | |
|--|--|
| 1. Telecommuting | 10. At-home agents |
| 2. Video conferencing | 11. Document image storage/retrieval |
| 3. Multipoint screen sharing | 12. Data conferencing |
| 4. Customer service call handling | 13. Multiple ISDN on single BRI loop |
| 5. Telephone/workstation integration | 14. Transparent operation w/ ISDN PBXs |
| 6. Image communications | 15. Frame relay support |
| 7. Remote communications to LANs | 16. Centralized fax server w/ISDN access |
| 8. Automatic number ID/calling line ID | 17. Engineering workstation ISDN interface |
| 9. High-speed file exchange | |

These applications were contributions from organizations such as: (in alphabetical order) Appalachian State University, Defense Information Systems Agency, Delaware State College, Environmental Protection Agency, General Motors Corporation, Internal Revenue Service, JC Penny, Jersey State College, Jet Propulsion Laboratory, Lawrence Livermore Laboratory, National Information Technology Center of Maryland, Naval Air Weapons Station, Prodigy Services Company, University of Cincinnati, University of Louisville, U.S. Total Army Personnel Command, and many, many others who have participated in the development of the NI implementation agreements.

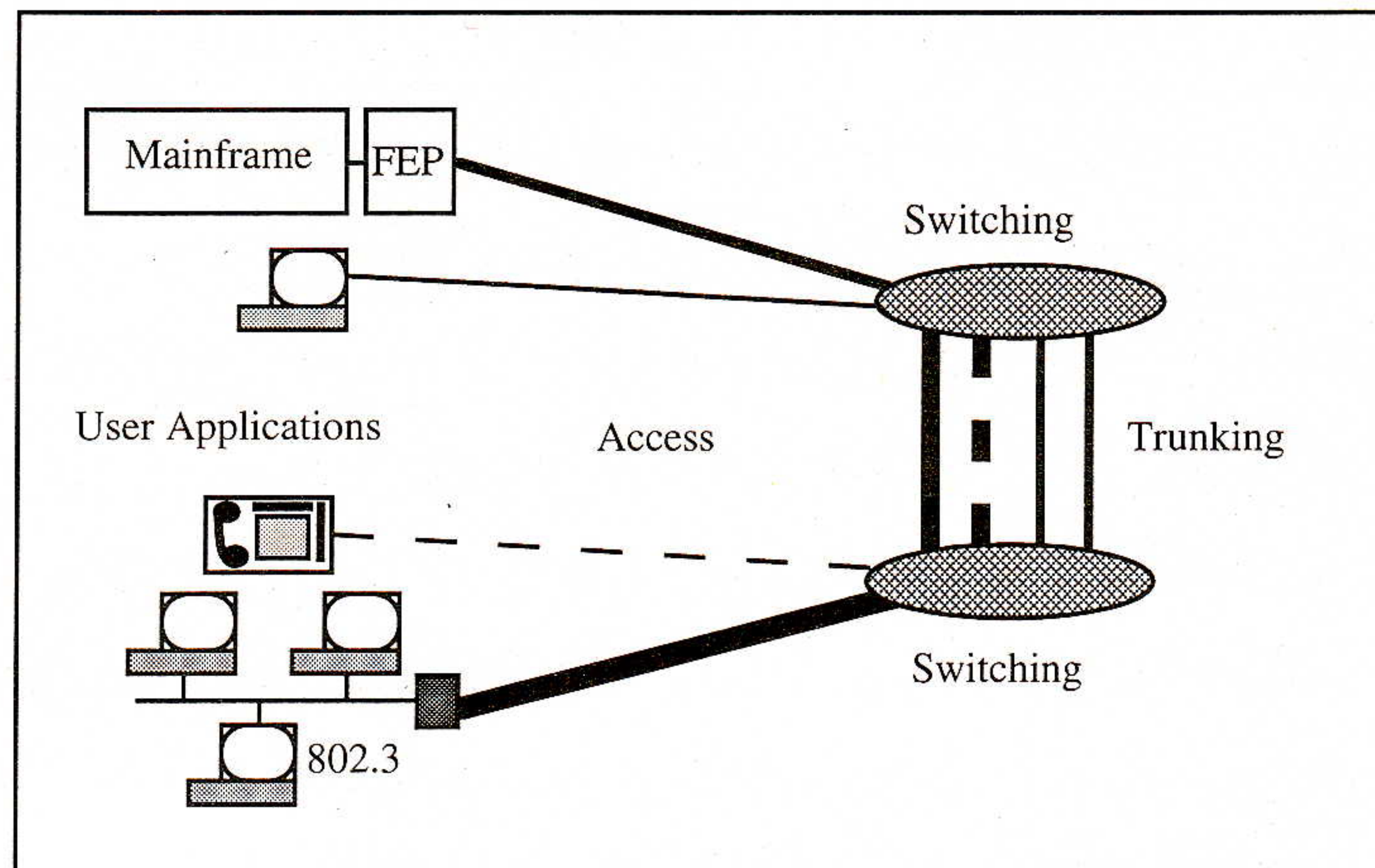


Figure 2: Generic Network Structure

National ISDN structure

National ISDN [13] develops a specification for the implementation of a standard, all-digital, nationwide network that should be deployed by the local exchange carriers over the 1993 to 1996 timeframe. NI deployment began before year-end 1992 as the *Local Exchange Carriers* (LECs) began deployment of National ISDN-1 (NI-1) generic software in selected central office serving areas. National ISDN-2 (NI-2) capabilities are expected to be delivered to the LECs for deployment during 1993 to 1994, and National ISDN-3 (NI-3) is expected to follow during the 1994 to 1995 timeframe.

NI-1 will create a platform of consistent network interfaces and features across all of the participating switch vendors which will allow terminal and protocol portability for the first time in the USA. NI-2 will provide more features, interface configurations and a standard *Primary Rate Interface*. NI-1, NI-2, and NI-3 will progressively deliver more features and functionality until the structure of NI is in place during the 1995–1996 timeframe.

“Customer needs, environmental factors, technological innovations that put more power into the hands of the user at lower cost, and the availability of a technically advanced, relatively inexpensive, and widely deployed NI network service, are creating a synergy that favors wide acceptance and application growth.” [14]

To verify these and other claims, an event was planned to showcase the availability and maturity of the NI applications and access in live demonstrations. The event was called *TRans-continental ISDN Project 1992*, or TRIP '92. This event marked the beginning of the National ISDN network deployment. Twenty two central offices equipped with NI-1 software were interconnected through a *Common Channel Signaling* (CCS) and *Interexchange Carrier* (IC) 64Kbps Clear Channel Capability.

continued on next page

Enterprise Networking & National ISDN (*continued*)

This beginning network provided NI services coast-to-coast and border-to-border. Two ICs provided voice/data interconnections, and two other ICs provided packet switched interconnection. This event took place during the week of November 16, 1992 with participation by seventy companies, at 150 sites in 26 states, seven Canadian Provinces, Europe, the Pacific Rim, and Australia.

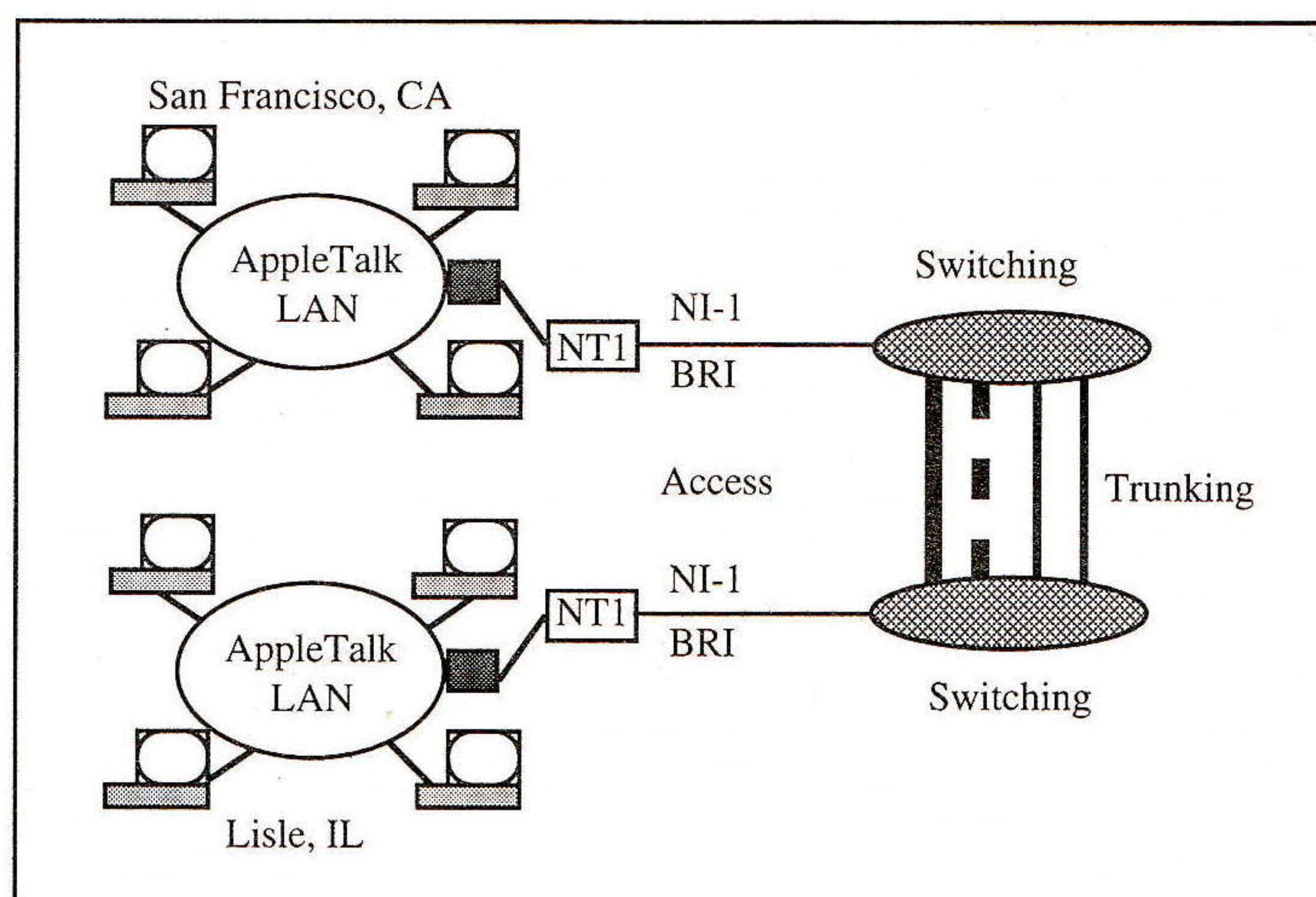


Figure 3: LAN Interconnection Over NISDN

LAN Interconnection

This application interconnects several AppleTalk® LANs together into a single internetwork using TransTalk® AppleTalk routers, through Hayes® external terminal adapters, over the National ISDN network. TransTalk routers enable full network-to-network connections so that the users on any of the interconnected AppleTalk LANs can easily share the services, applications, or even the computers of any other LAN. The benefits of LAN interconnection over ISDN are:

- High speed, digital connectivity
- Resource sharing of services, applications, and computers
- Multiple levels of security and
- Centralized LAN management capability.

The most exciting feature of this dynamic network is the centralized management software which enables global network changes to be administered only once. Easy-to-read, graphical maps display network activity statistics for the internetwork, and allow the administrator to perform management and configuration tasks from anywhere in the network, even remotely.

TransTalk routers use the 56/64 Kbps synchronous capability of the Hayes ISDN System Adapter to interconnect AppleTalk LANs. Multiple levels of network protection are available including passwords and call-back security. This is demonstrated using applications such as file transfer between disks of attached computers, or screen sharing applications which "take over" the resources of another computer on the network. Bellcore TEC in Lisle, Illinois interconnected with an AppleTalk LAN at International Transware in Mountain View, California, Business Link in New York, and France Telecom in Paris, France during the week of TRIP '92.

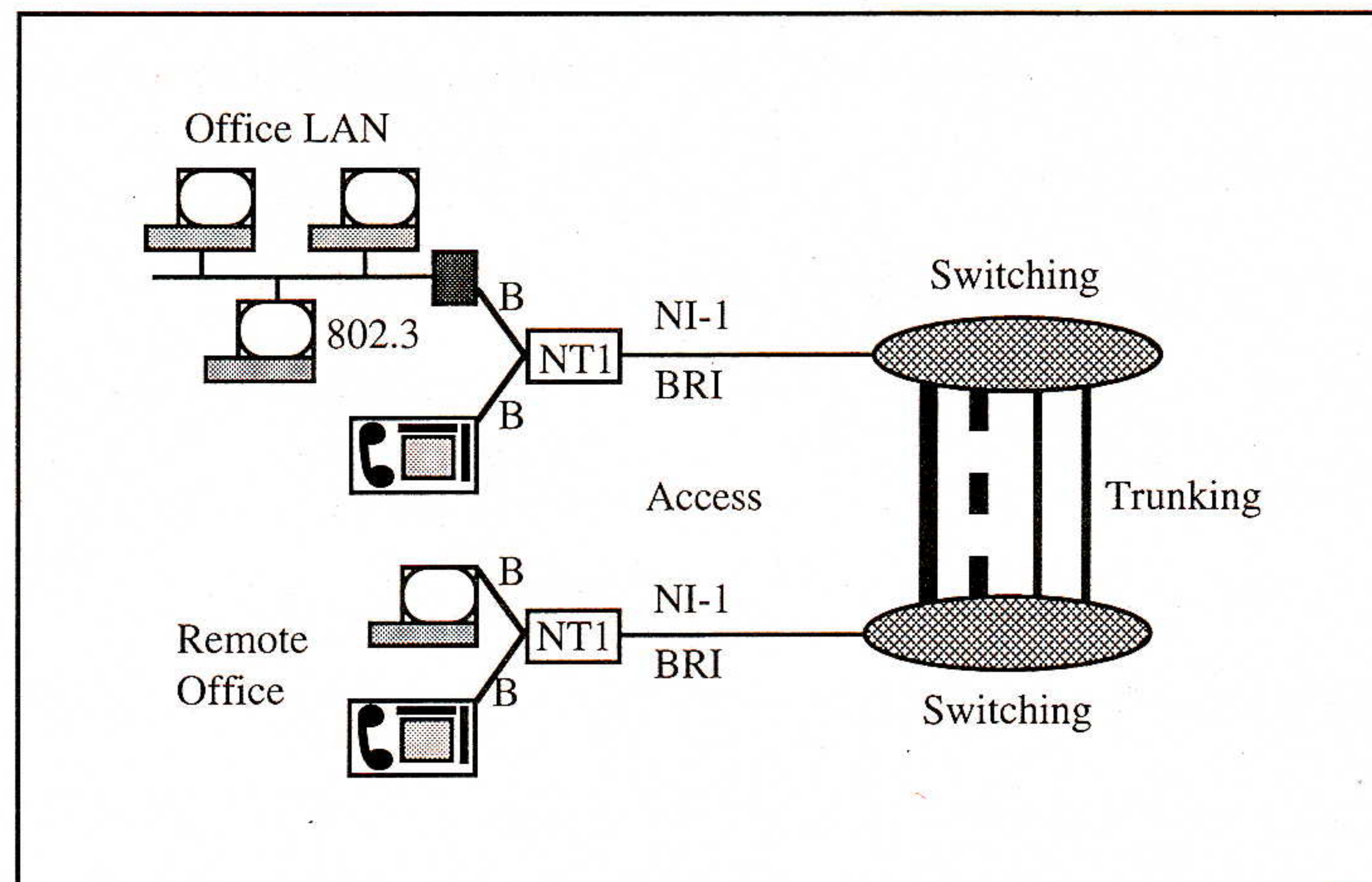


Figure 4: Telecommuting Over ISDN

Telecommuting

According to Link Resources, 8.6 million people telecommute at least part of the time. ISDN is the perfect vehicle for telecommuting applications with its higher data rates (64Kbps) and relatively inexpensive cost. For example, employees can easily work at home by using a NeXTstation™ computer workstation and a Hayes ISDN Extender™ external terminal adapter. The synergy between these two products gives telecommuting employees the freedom to easily create a cost-effective, digital, dial-up link to their computing resources.

By simply double clicking on the telephone icon, employees at home use ISDN to create their network lifeline to the office, and open a telecommuting environment. They can access all the resources on the network as if they were at their desks at the office—including seamless network access to remote file systems, electronic mail, servers, printers, and fax modems. The benefits of the telecommuting application are:

- Social, economic, and legal imperatives are satisfied
- Cost effective, digital, dial-up connectivity
- Desktop access to all networked resources, such as remote databases, electronic mail and, remote file servers.

The remote user of this application will be using TCP/IP over ISDN. This dynamic match allows employees to enjoy a seamless WAN Connection to their business location. TCP/IP is the most popular protocol for LAN/WAN connectivity today. Bellcore TEC demonstrated the power and ease of using this incredible platform with ISDN BRI by accessing “corporate” facilities in San Francisco, California from the Lisle, Illinois location.

Delivering computer based training

Computer Based Training (CBT) can be applied to a scenario in which the instruction or database is located remotely from the student. This application shows the effectiveness of accessing a remote site at 64Kbps, on demand, using ISDN Desktop Conferencing technology to get access to CBT, and then conveniently “learning” about a subject from one or more remote sites.

By matching CBT and ISDN, we are capable of crossing geographic boundaries, and providing a learning experience which is cost effective, convenient, and easy to use. The NI technology provides both voice and non-voice capability.

continued on next page

Enterprise Networking & National ISDN (*continued*)

For example, a Bellcore developed Computer Based Training course entitled "ISDN—A Closer Look" is an excellent training tool as introductory material on the topic of ISDN. This course can be shared between multiple locations by loading the course on a "host" personal computer connected to an ISDN Basic Rate Interface line, and then, at random, accessing this computer from remote PCs also connected to Basic Rate lines using software packages like pcAnywhere™, and allowing the remote students to take the course at their convenience. The class takes about two hours to complete, including a series of tests on the course material.

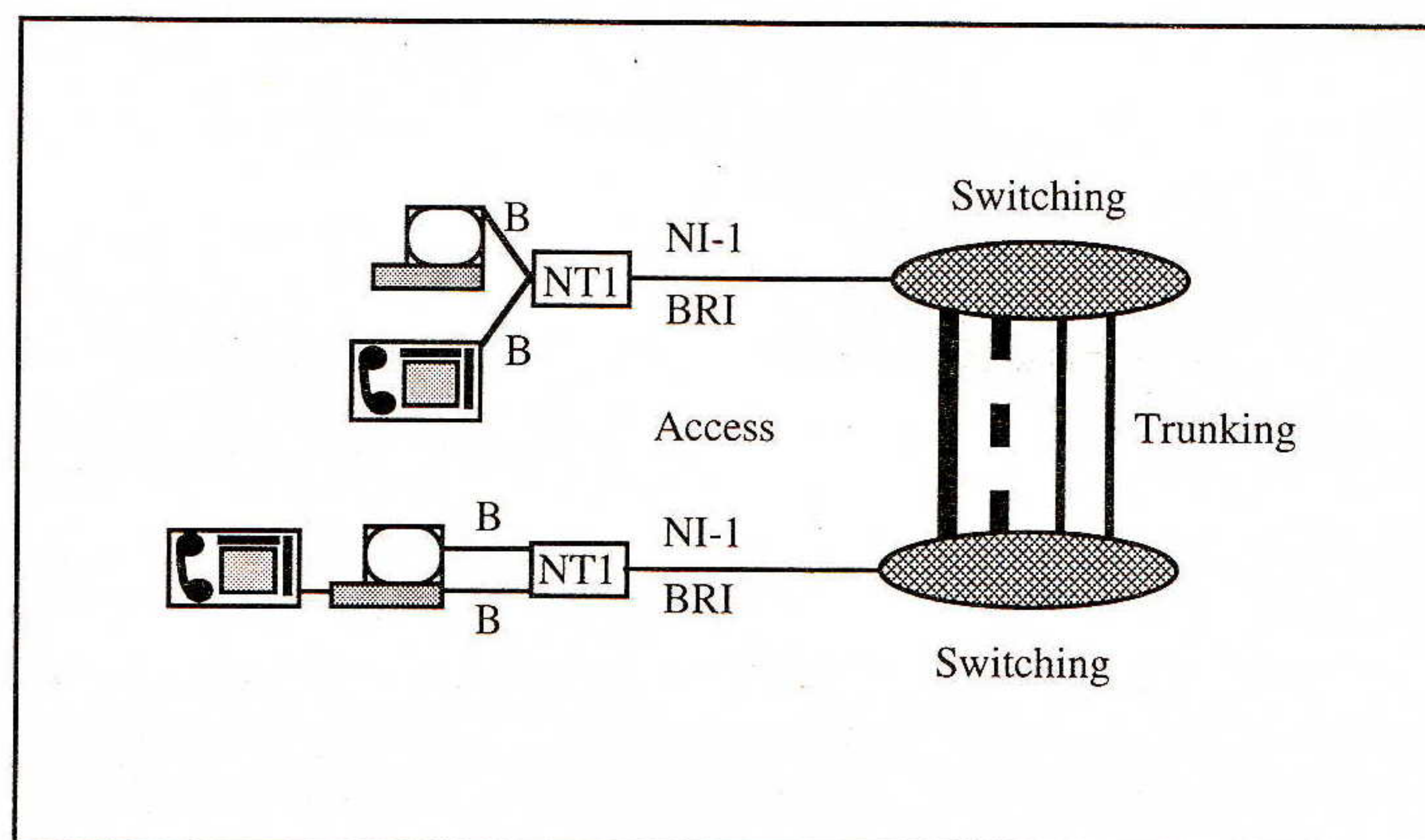


Figure 5: Delivering CBT on ISDN

The benefits of using ISDN to deliver CBT are:

- On-demand training and information
- Shared database resources
- Minimizes data redundancy, license fees
- Local or remote access
- High speed, digital transfer
- Conveniently delivers knowledge to the user.

This application is an excellent example of using ISDN to teach ISDN, making the information age a reality.

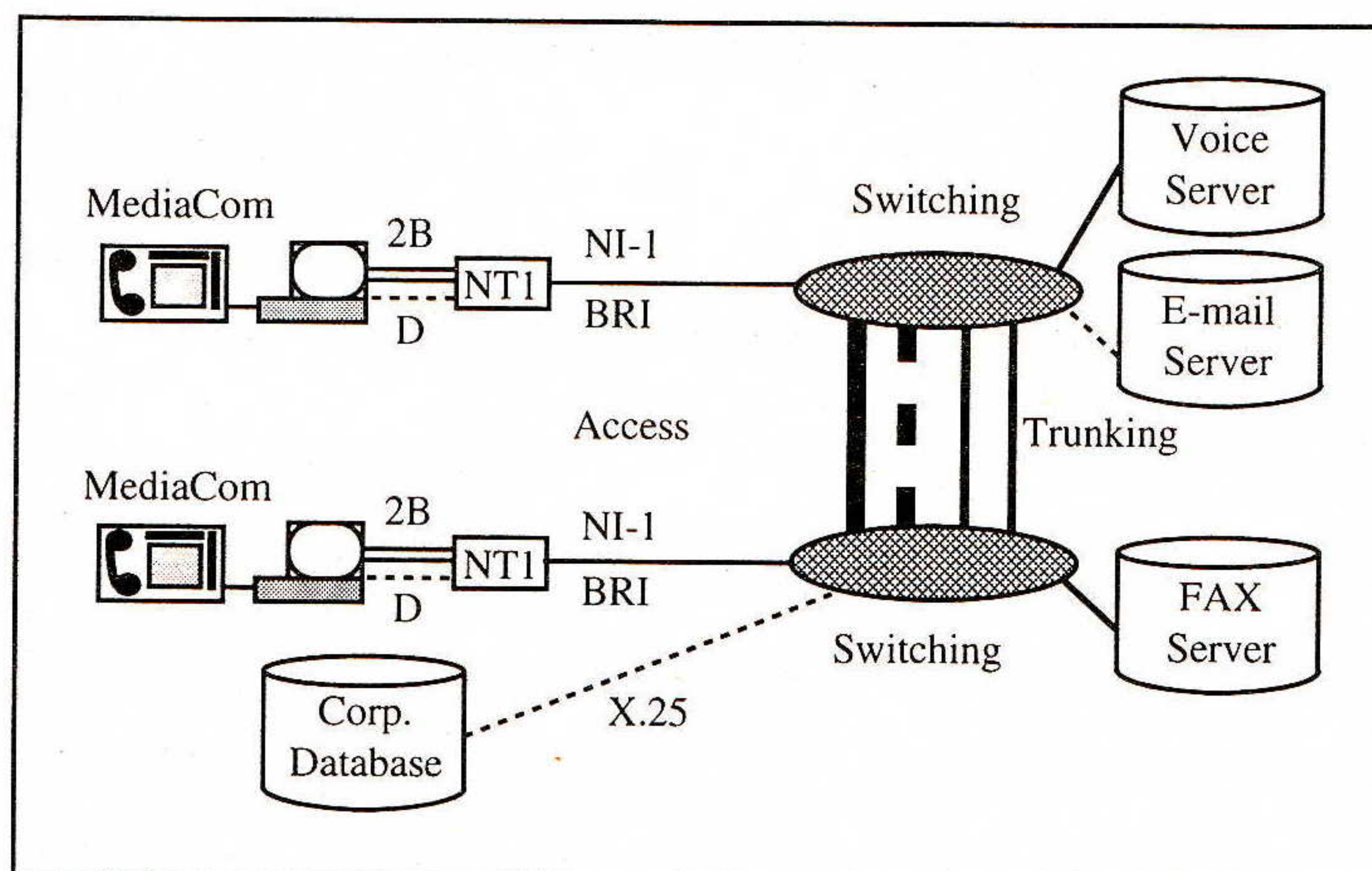


Figure 6: MediaCom™

MediaCom

MediaCom software is a PC based ISDN application which provides unique access and control of network based servers. The strong functionality of MediaCom software is accomplished with X.25 packet messaging using the ISDN D channel. This permits fast directory queries and unparalleled server control. The B channels are used for call completion to ISDN or non-ISDN devices, and for retrieving voice messages stored on a network based voice messaging server. MediaCom software makes for easy multiparty conferencing setup of up to six parties. MediaCom software benefits are:

- User friendly ISDN interface
- Integrated desktop functionality
- Cost-effective sharing of network based services.
- A single ISDN interface for voice mail, electronic mail, & fax
- Unified message notification/retrieval

MediaCom software is a one-step message and call completion center integrating voice, e-mail, fax, and directory functions. Using simple screen listings, a MediaCom software user can review all incoming voice and e-mail messages, click on those he/she wishes to review, and immediately read or hear the messages. Another click and the user is instantly able to reply via e-mail, fax, and/or voice. A convenient directory function provides a means to derive proper addresses for outgoing calls and messages.

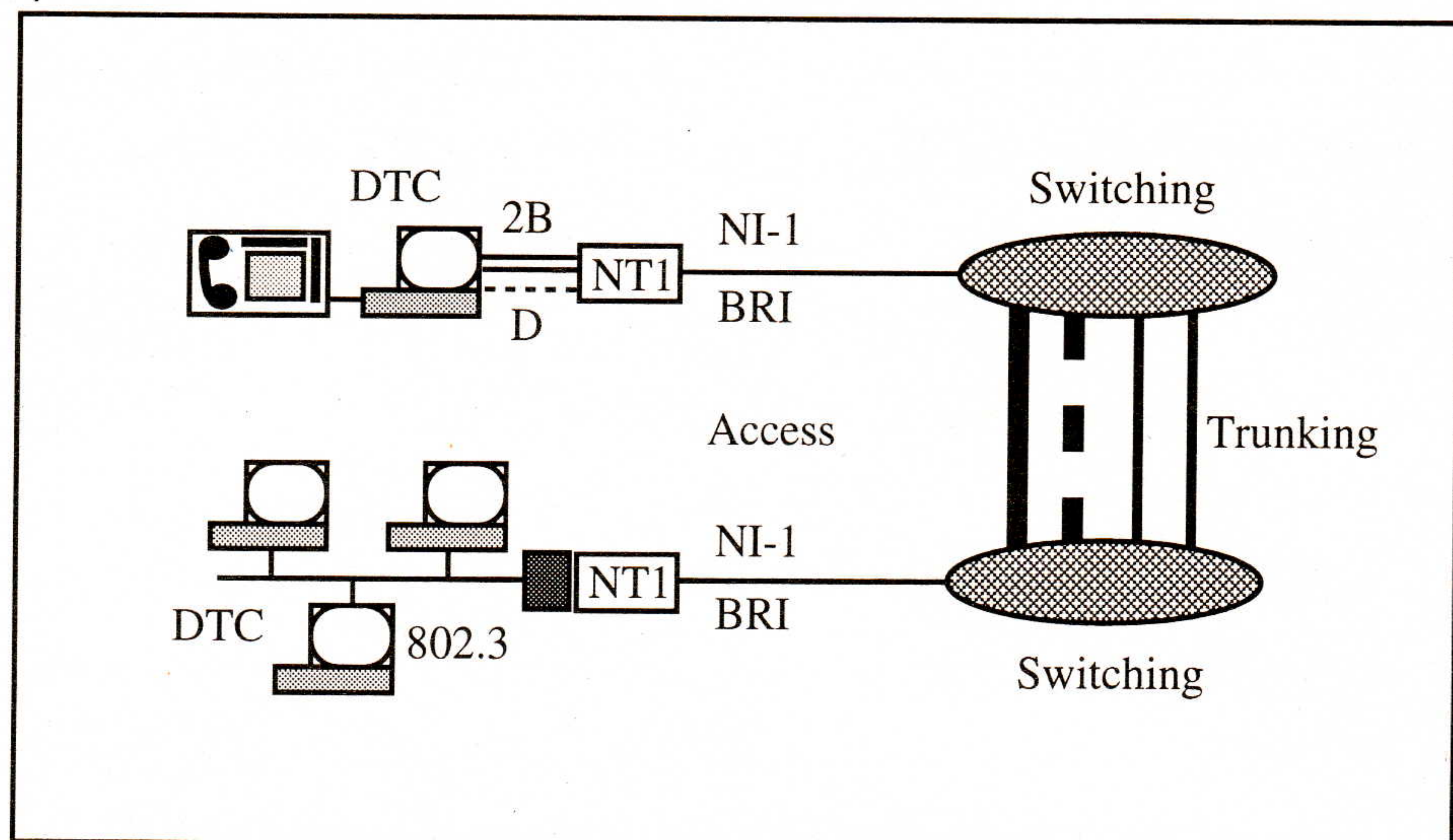


Figure 7: Joint Editing, Financial Reporting and Review

Joint editing, financial reporting and review

Joint editing is a specific type of Desktop Conferencing application. A 386/486 based PC with a Basic Rate Interface terminal adapter board is connected via Basic Rate Interface across a network to another Basic Rate Interface and a PC, Host CPU or LAN server. The benefits of Joint Editing are:

- Graphical user interface sets up the call
- Uses a typical Windows™ and PC environment
- Simultaneously view/annotate in real-time
- Decisions can be made on the spot
- Any changes are updated on all screens.

Enterprise Networking & National ISDN (*continued*)

Two users can interact on several different reports and accomplish major revisions to business documents in short time. This application uses the full 64Kbps bandwidth of one B channel for changes, while allowing voice interaction on the second B channel. This application is a great tool for situations such as work-at-home or remote LAN access.

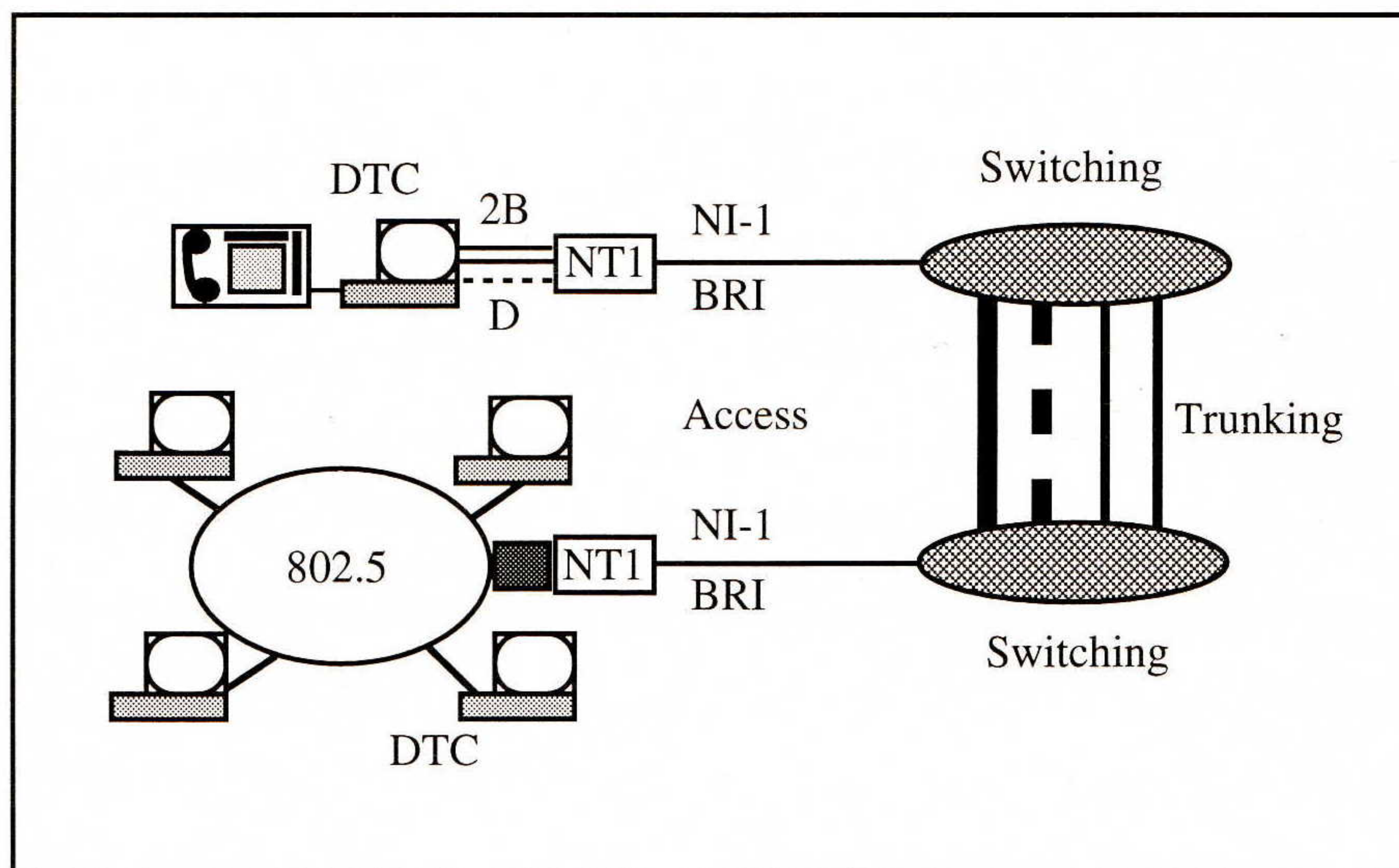


Figure 8: Desktop Conferencing

Desktop conferencing

Desktop conferencing is a Basic Rate ISDN application which can take on many specific implementations such as Remote Diagnostics, Call Management, Computer Based Training, Joint Editing, and others. In this example, a 386 based PC with a Basic Rate Interface terminal adapter board is connected via Basic Rate Interface across a network to another Basic Rate Interface and a PC, host CPU or LAN server with Desktop Conferencing software at each end.

In the OS/2® environment, Desktop Conferencing allows a user to have true multi-tasking capabilities. An individual can work in multiple areas of voice and non-voice concurrently. This allows the user a vast amount of flexibility in a local and remote environment. For example, the user can be working on a spreadsheet, transfer to another application to send a screen of high quality graphics to another location in a few seconds, and return to the spreadsheet without jeopardizing any data or process. The benefits of Desktop Conferencing are:

- Single user can run multiple applications simultaneously
- Applications can be operated remotely
- Remote database inquiries
- Remote access to diagnostics, or help desks.

Desktop Conferencing is a solution for customers in many business environments who need to use the ISDN bandwidth to transfer large volumes of text and graphics.

Remote database access

Remote Database Access is a powerful ISDN application that takes advantage of unique features of ISDN *Circuit Switched Voice* (CSV), *Circuit Switched Data* (CSD) and Supplementary Services such as *Calling Line ID* (CLID) in customer service applications.

Customers calling a service agent served by an ISDN Basic Rate line will have their calling number delivered to the Service Agents system. This system will immediately launch a call on a B channel across the network to query a remote data base to find a match for the calling number. The customer account information from successful matches will be returned over the second B channel to the Customer Service Agent and will be in a pop-up window at the time the call is delivered to the Agent.

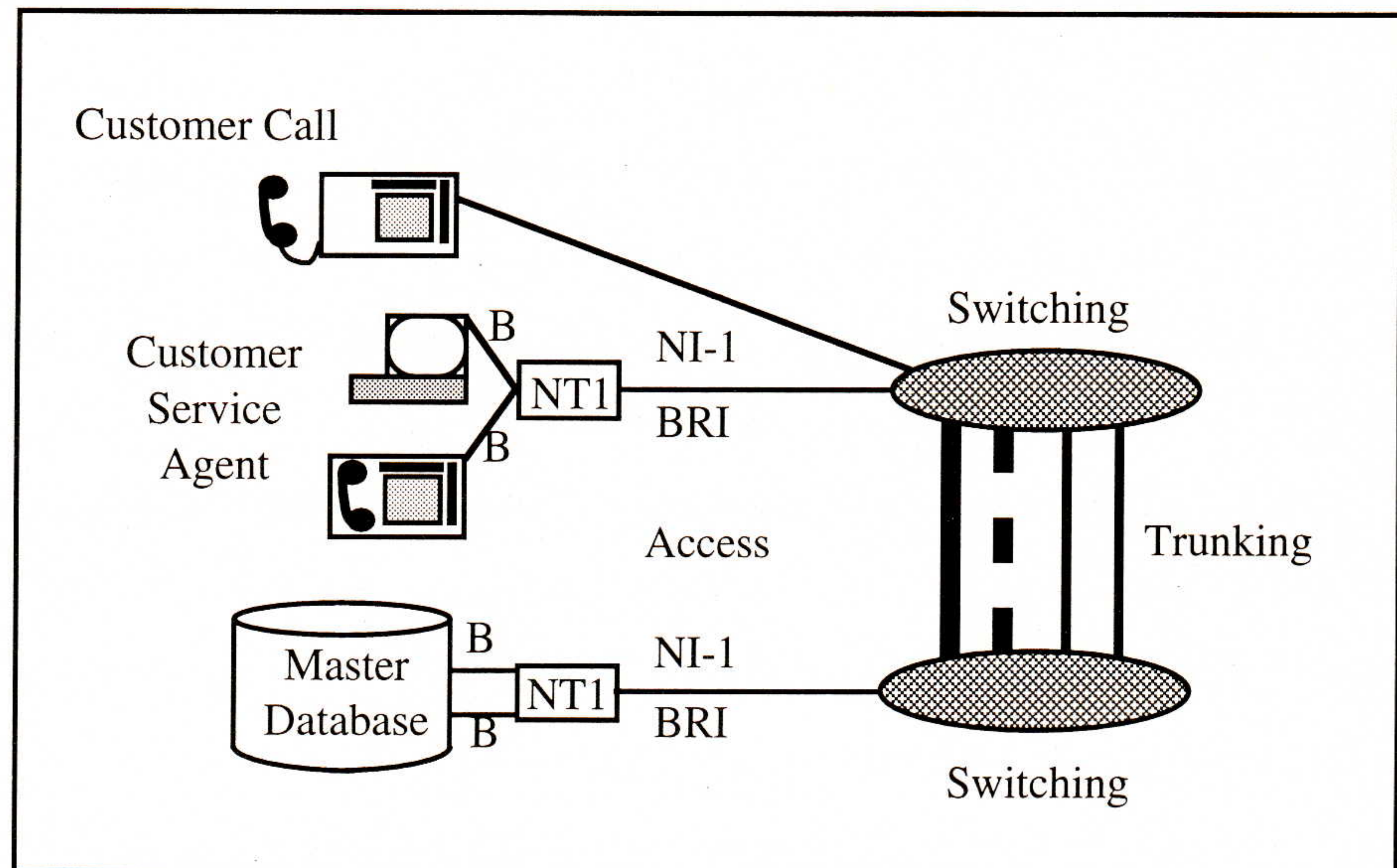


Figure 9: Remote Database Access Using Calling Line ID Over ISDN

The benefits of Remote Database Access using call ID application are:

- Simultaneous, multi-user access to a central database via ISDN
- Retrieval of incoming caller information via ISDN D channel signaling
- Ability to make data connection and retrieve information from remote databases while on another call
- Use off-the-shelf applications software in the ISDN environment.

This system, known as XLCALLERID®, illustrates a new application that combines existing software with ISDN capabilities. The Hayes ISDN PC Adapter™ can provide the ISDN access for both signaling information and for multiple simultaneous voice and data calls. The Bellcore TEC lab demonstrates the ease with which these multiple operations can be performed, and how any DOS-based personal computer works exceptionally well in this ISDN environment.

Desktop videoconferencing

Desktop Videoconferencing promises to act as a strategic tool that facilitates the timely exchange of ideas among geographically dispersed locations. The Cameo Personal Video™ system addresses this promise over standard ISDN telephone lines by delivering two-way, full-color, motion video with voice. Other applications can run concurrently while conducting a video call.

The standardized implementation of NI by all LECs will allow for implementations to occur coast-to-coast without regard for vendor proprietary protocols at the network interface and in the feature interaction across the network.

Enterprise Networking & National ISDN (*continued*)

The Cameo Personal Video system includes a small video processor module, which sits next to the personal computer and plugs into the computer's serial port. The camera fits comfortably on top of the monitor and is lightweight, compact, and adjustable. The camera is focus-free and ranges from 2 to 7 feet.

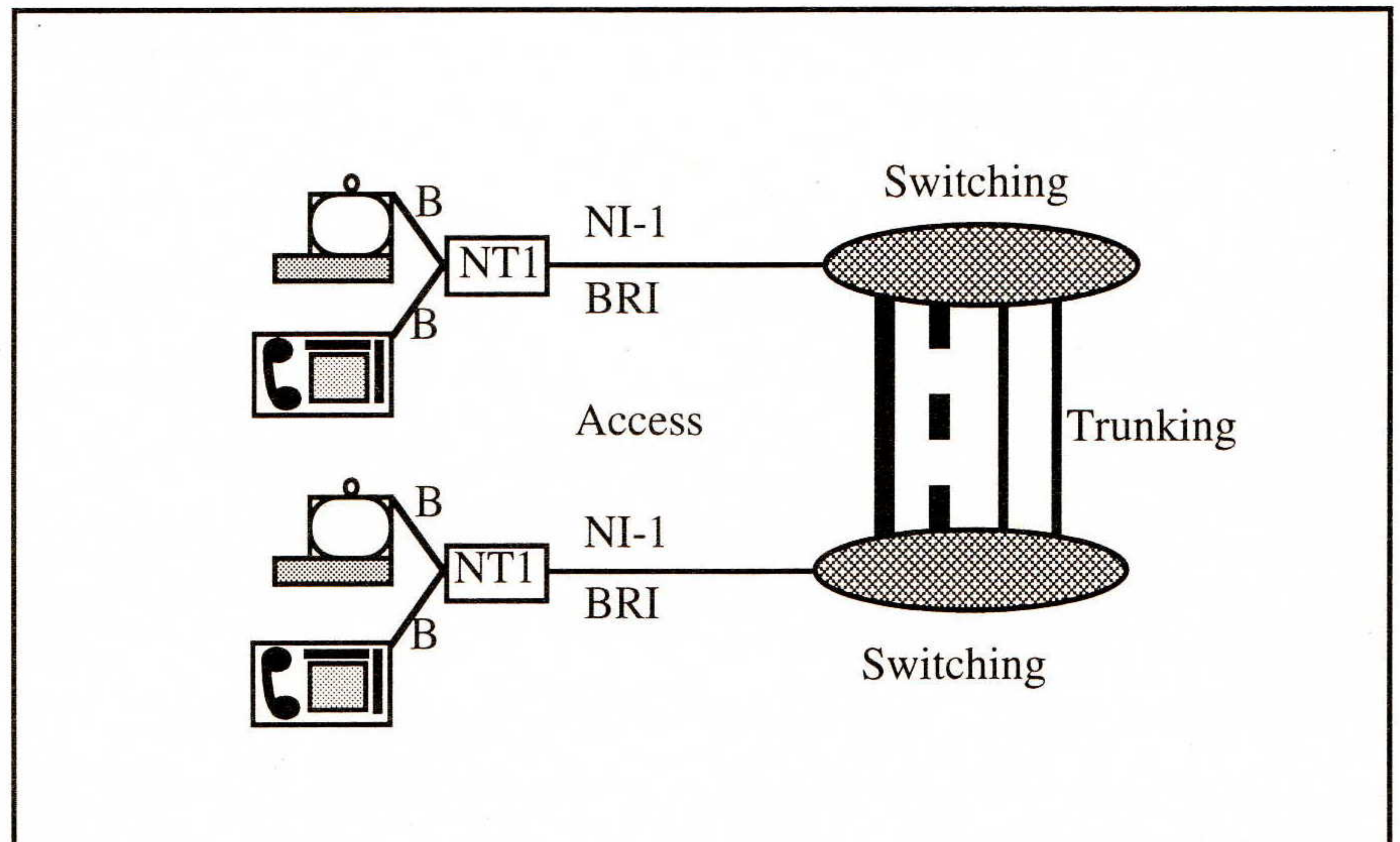


Figure 10: Desktop Videoconferencing using ISDN

The benefits of the Desktop Videoconferencing application are:

- Two-way, full color, motion video with voice
- Integrates directly into existing PCs
- Low cost, user friendly
- Other applications can be active while conducting a video call
- Requires only one Basic Rate Interface

Basic telephony software is included with the system's simple user interface such as:

- Hold, for audio and video
- Audio mute
- Telephone list auto re-dial
- Self view mode

Callers can end video transmission at any time by closing a shutter over the lens.

Bellcore TEC has establish videoconference connections with Compression Labs, Inc. in San Jose, California and France Telecom at a location in Reston, Virginia. Desktop Videoconferencing supplies an affordable solution to everyday business needs.

Still video image transmission

Still Video Image Transmission using ISDN allows the user to transmit and receive high-quality images over the public network. Transceivers can accept electronic images for transmission (or compression) from almost any image source such as:

- Video cassette recorders/players
- Stored images (which are computer based)
- Optical disk players and video cameras.

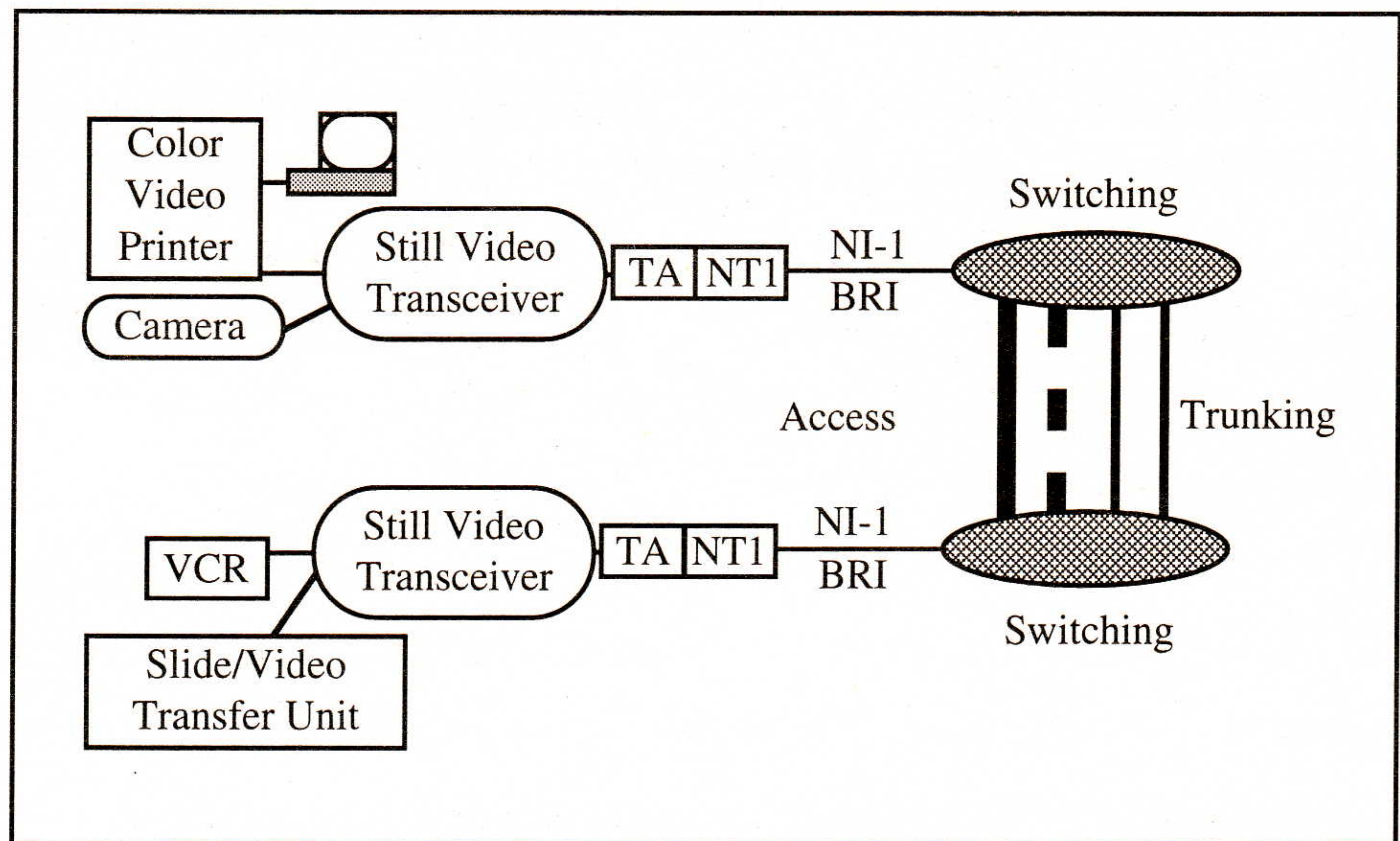


Figure 11: Still Video Image Transmission

The benefits of Still Video Image Transmission are:

- 64Kbps transmission rates
- Short connect times
- High resolution
- Multi-media integration.

Still Video ISDN connections utilize Circuit Switched Data connections and Common Channel Signaling with SS7 Protocol to pass the ISDN information from one central office to the other. This application shows the usefulness of ISDN to support:

- Engineering projects and design consultation,
- Law enforcement activities such as fingerprint transmission
- Teleradiology—high resolution X-rays.

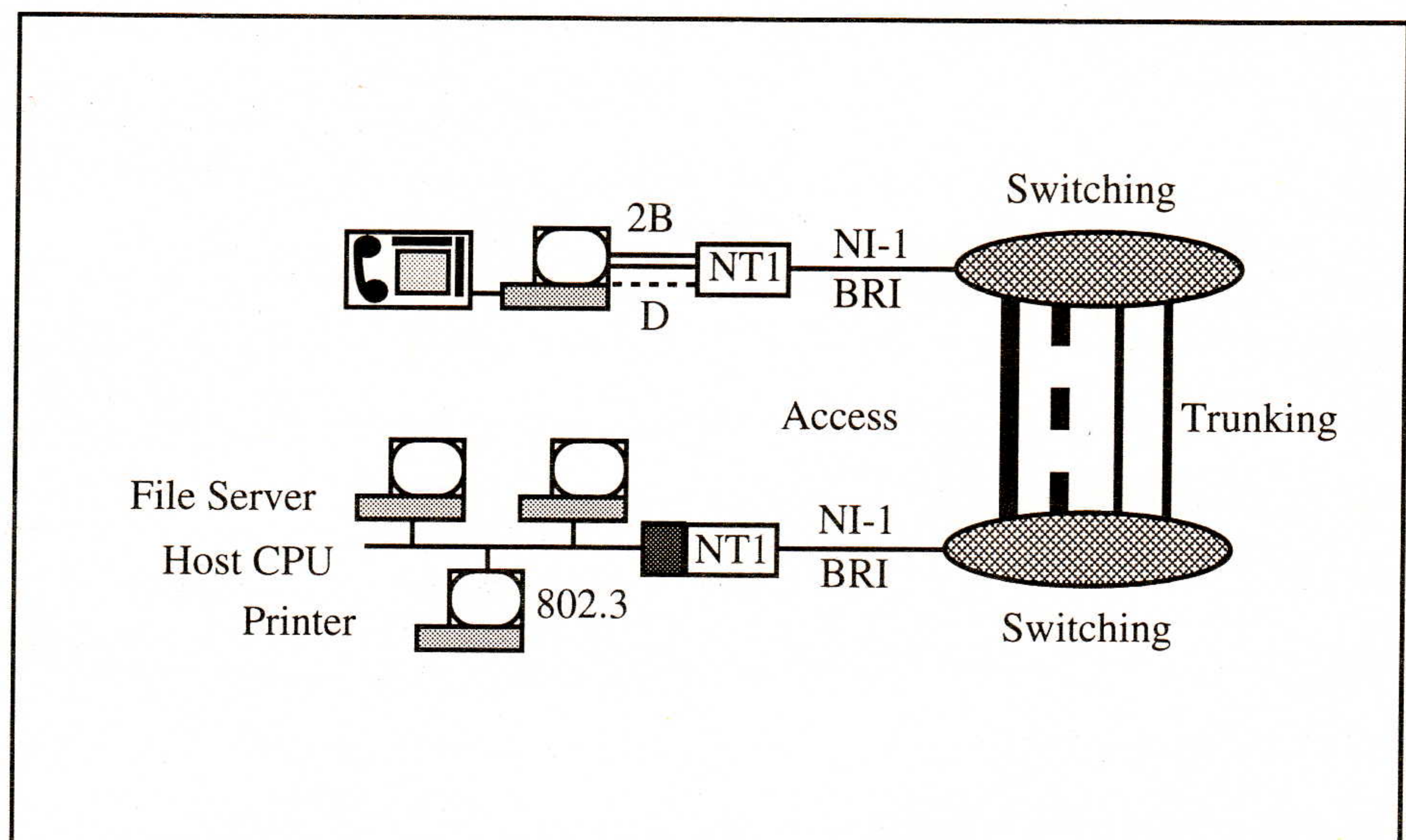


Figure 12: Remote LAN Access: Ethernet Bridging

Enterprise Networking & National ISDN (continued)**Ethernet Bridging**

This application shows how multiple users can get low cost WAN access to all LAN resources. Basic Rate ISDN lines provide high speed, digital, dial-up access to these centralized resources. When large amounts of information must be transferred between a remote user, such as a branch office, and resources on a Local Area Network, the user can connect to a port on a LAN adapter using a B channel at 64Kbps, or two B channels at up to 128Kbps. The benefits of Ethernet Bridging are:

- Low cost WAN access to all LAN resources
- "Broadcast" of hard copy or electronic images
- High speed digital, dial-up access to host computers, printers, file servers and fax servers

ISDN Basic Rate Interface and Remote LAN Access will support applications such as research, engineering, government, education, media and insurance to name a few.

Summary and conclusions

In summary, this article has established the premise that a strong synergy exists between Enterprise Networks and National Integrated Services Digital Networks (ISDN) to the extent that ENs and NI will benefit from each other, therefore refuting the argument that the deployment of ISDN (in the form of National ISDN) is "too late."

The composition of the EN was discussed in terms of applications, access, switching, and trunking to show that the technologies and architectures of the EN are complex, numerous, difficult to integrate, difficult to manage, and in a constant state of transition.

The NI architecture was then defined to show that the predominant position of NISDN is in access and switching at the application level, and therefore has a role to play in support of, not in conflict with, the typical, limited view of an EN as a series of high speed backbone links.

Instead, ISDN can serve as a tributary and/or access technique; it (NI) can play a meaningful role in hybrid networks. [15] As of 1991, approximately 300 large companies have subscribed to some form of ISDN services. [16] After the successful showcase of NI applications created by the nationwide TRIP '92 activity, 1993 is expected to be a year in which the promise of ISDN will finally be realized in the form of National ISDN.

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Distributed Computing with Object Management

by Tom Mowbray and Ron Zahavi, The MITRE Corporation

Introduction

Every major new networking technology has held out the promise of interoperability between disparate systems and applications. Today, connectivity between most computing platforms is readily available; however, interoperability at the application level remains elusive. Reasons include the inherent difficulty of distributed programming and the lack of standard interfaces between applications. In addition, standard interfaces are needed to manage the multitude of distributed objects that reside on different systems. Since its introduction 10 years ago, remote procedure call (RPC) technology has generated few popular interfaces; Network File Server (NFS) is perhaps the only widely used RPC interface definition.

The *Object Management Group* (OMG) is an international industry consortium whose mission is to define a set of interfaces for interoperable software using an object-oriented approach [1]. Their first specification, the *Common Object Request Broker Architecture* (CORBA) is an industry consensus standard that defines a higher level facility for distributed computing [2]. In general, object-orientation enables the development of reusable, modular software, and it is moving technology towards plug-and-play software components. The OMG's efforts are extending these benefits across distributed heterogeneous systems.

OMG does not sell or develop software; its primary role is the selection and promulgation of software interfaces. The OMG uses an industry consensus process that results in rapid commercial product support for its standards. The OMG standardization process includes *Requests for Information* (RFIs) and *Requests for Proposals* (RFPs) similar to other standards groups. Once these are passed by vote of the Technical and Business Committees, the OMG Board of Directors votes to convey final approval. The OMG also sponsors *Special Interest Groups* (SIGs) covering related topics, such as object oriented methodology.

Object Management Architecture

Figure 1 is an overview of the OMG's *Object Management Architecture* (OMA). The OMA Guide was first published in 1990 and identifies four areas for standardization [1]. The central component of the architecture is the *Object Request Broker* (ORB). The ORB functions as a communication infrastructure, transparently relaying object requests across distributed heterogeneous computing environments.

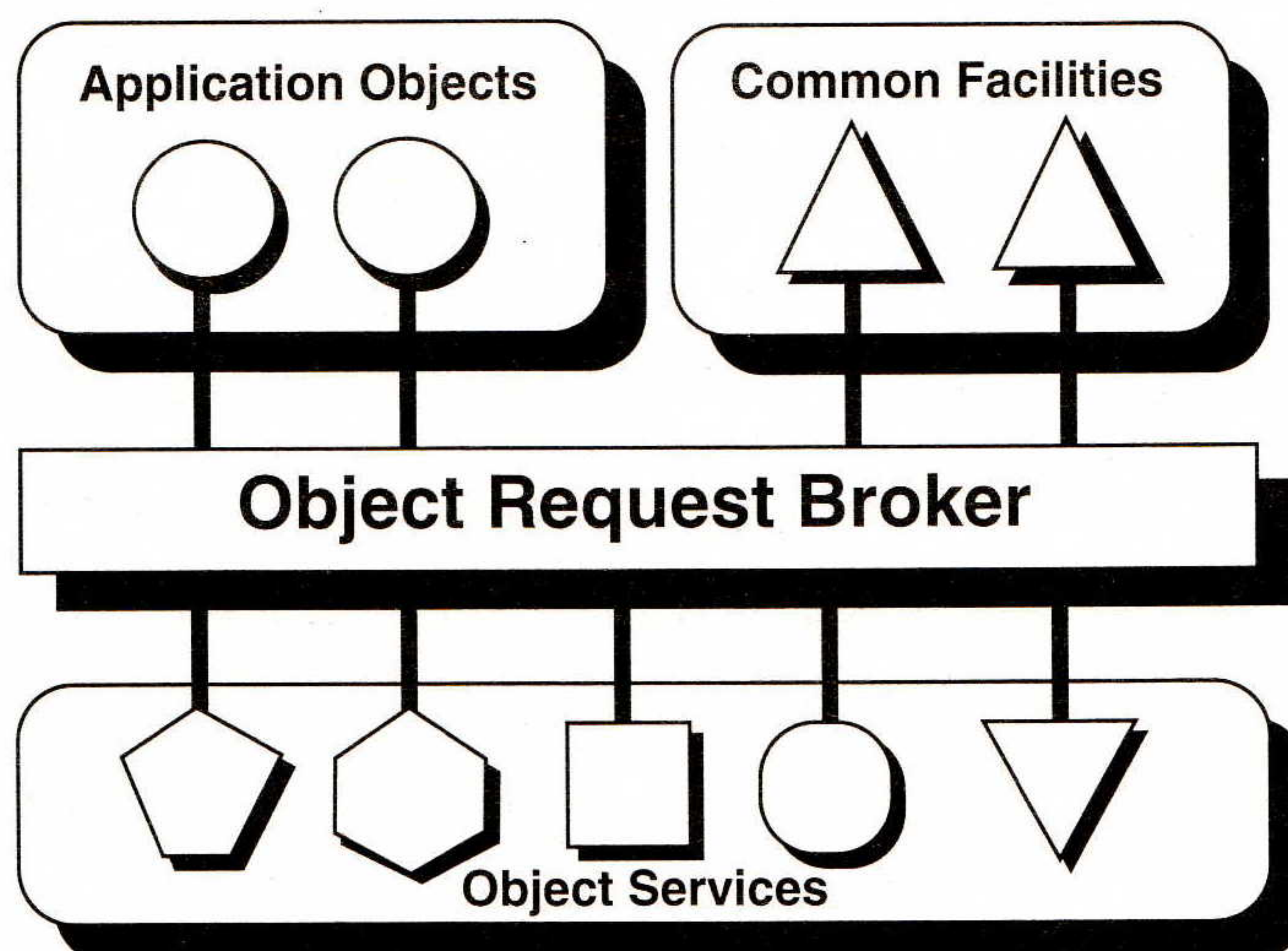


Figure 1: Object Management Architecture

The CORBA specification covers all the standard interfaces for ORBs. *Object Services* comprise a set of lower level services such as object creation and event notification. *Common Facilities* comprise a set of high level services such as printing and e-mail. *Application Objects* comprise all the remaining software including developer's programs, commercial applications, and legacy systems.

Much of the OMG standards activities focus upon the three architecture areas: ORB, Object Services, and Common Facilities. The ORB standard, CORBA 1.1, was adopted in December 1991 [2]. CORBA 2.0 extensions are in the adoption process, including a C++ binding, ORB interoperability/initialization, and the *Interface Repository*. Future CORBA 2.0 activities include an *Ada* mapping, a *Smalltalk* mapping, and a *COBOL* mapping. The OMG has approved an initial set of three object services and is actively engaged in the adoption of additional services (see Object Services below). The adoption process for common facilities has recently started.

CORBA simplifies distributed systems in several ways. The distributed environment is defined using an object-oriented paradigm that hides all differences between programming languages, operating systems, and process locations. The object oriented approach allows diverse types of applications to interoperate at the same level, hiding implementation details and supporting reuse. CORBA provides a portable facility for defining interfaces called the *Interface Definition Language* (OMG IDL). Object Services defined in OMG IDL have a dual role: ORB vendor provided services and application provided services. Developers are encouraged to reuse and extend the standard interfaces.

Object Request Broker

As the industry standard for object request brokers, CORBA is an application level communication infrastructure. CORBA provides its communication facilities to applications through two mechanisms: static interfaces and the *Dynamic Invocation Interface* (DII). Both mechanisms utilize interfaces defined in OMG IDL. Other CORBA components include: an *Interface Repository* which stores on-line descriptions of the OMG IDL interfaces; and the *Basic Object Adapter* (BOA) which is an initial set of server interfaces for object implementations. CORBA also specifies a set of basic system objects, such as general purpose name-value lists and memory management.

CORBA is a peer-to-peer distributed computing facility where all applications are defined externally as *objects* (regardless of whether the application is object-oriented internally or not). Objects can alternate between client roles and server roles. An object is in a client role when it is the originator of an object invocation. An object is in a server role when it is the recipient of an object invocation. Server objects are called *object implementations*. Most applications will play both client and server roles. Thus, CORBA supports more flexible architectures and communication schemes than pure client-server based RPC.

OMG IDL

OMG IDL is a technology independent syntax for describing object interfaces. The language defines interfaces comprising attributes, exception values, type definitions, constants, and operation signatures. OMG IDL facilitates reuse through inheritance between interfaces. Inherited definitions can be augmented to create specialized interfaces. Inheritance and specialization is an important way to reuse interface designs while retaining upward compatibility.

CORBA (continued)

OMG IDL specifications are compiled into header files and stub programs for use by programmers. OMG IDL can potentially support a mapping to any programming language. So far, vendors have implemented mappings to C, C++, *Smalltalk*, and *Ada*. CORBA defines a standard mapping from OMG IDL to the C programming language, and the C++ mapping standard is in advanced phases of adoption. OMG IDL compilers are bundled with ORB products and allow programmers to define portable compiler-checked interfaces.

In Figure 2, an OMG IDL interface is depicted for both client and server objects. The OMG IDL compiler generates header files, client stub routines, and server callback skeletons for each interface. The client's application program links directly to the client stub. From the client's perspective, the CORBA invocation is indistinguishable from a local function call. Transparently, the client stub provides an interface to the ORB which performs marshaling operations to encode and decode the operation's parameters for network transmission. The OMG IDL skeleton is the corresponding server side support for the interface. When the request is received by the ORB, the skeleton provides a callback to an application supplied function. When the server function completes processing of the request, the skeleton, ORB, and stub return the results to the client program, along with any exception information. In case of errors, exceptions can be generated by the server or by the ORB.

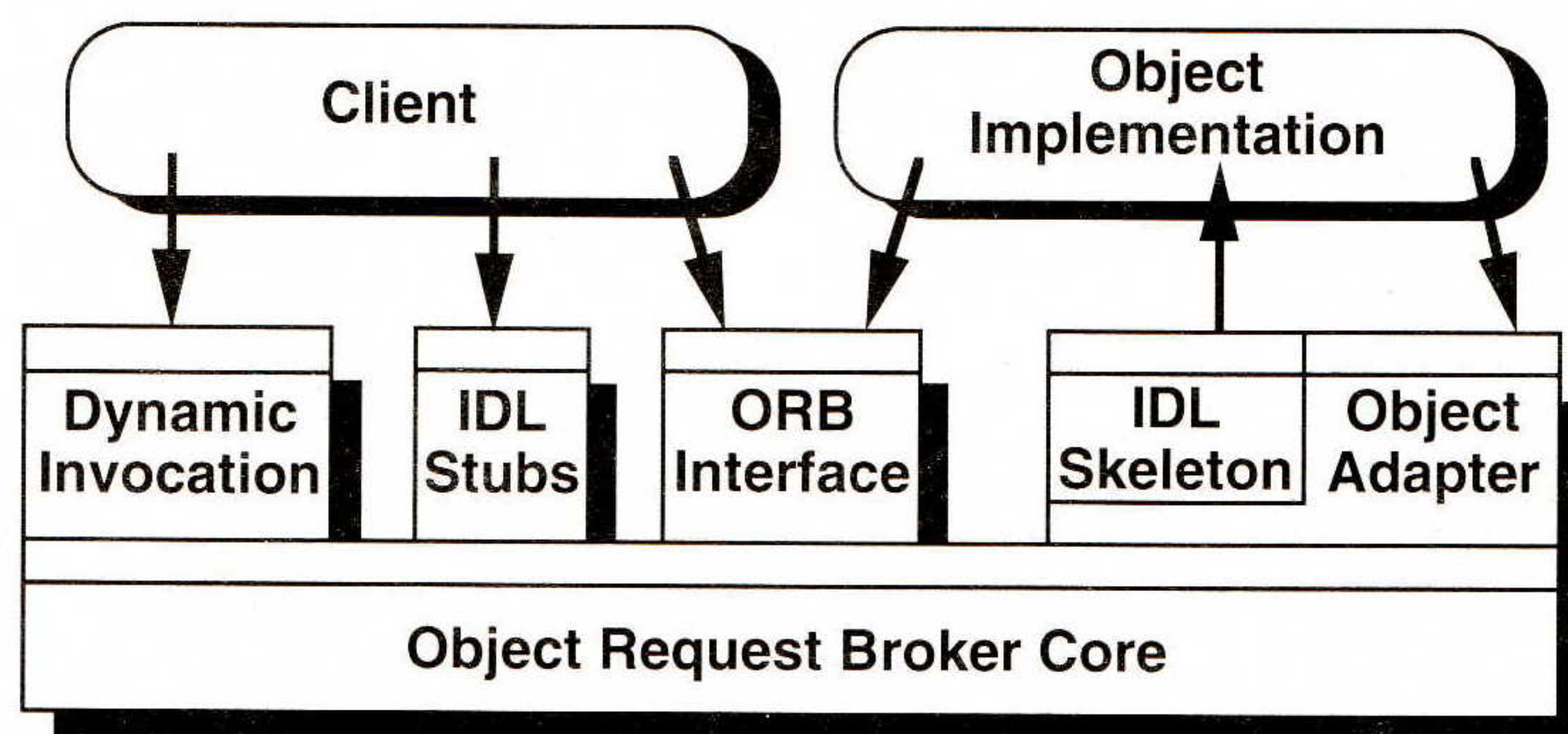


Figure 2: CORBA Interfaces

Dynamic Invocation Interface

Early ORB products were based almost entirely upon the DII. The DII is an alternative to compiled static interfaces. The DII is a generic facility for invoking any operation via a run-time parameter list. An OMG IDL metadata description of the operation can be retrieved from the CORBA Interface Repository. Using this metadata, a legal request can be constructed to a newly discovered object type. Use of the DII is transparent to the object implementations; both static and dynamic invocations are received through the OMG IDL skeletons. In the authors' experience, programming with static interfaces is much simpler and results in more robust code. However, the DII provides additional flexibility which is required by applications such as desktops and operating systems.

Object Adapter

The object adapter provides the server's interface to the ORB. Object adapters support functions such as object registration and server activation. There are several potential types of object adapters. For example, special purpose adapters could support object database systems or legacy integration. CORBA 1.1 only defines the Basic Object Adapter (BOA), but it recognizes the need for these other types of adapters.

The BOA is a general purpose object adapter. Figure 3 is an example of the BOA in operation. When a client request specifies an inactive server, the BOA automatically activates the server process (Step 1). The first responsibility of the server is to register its implementation with the BOA (Step 2). The BOA stores this registration for use in future object requests. After an object is activated (Step 3), it may receive client requests through the method callbacks in the OMG IDL skeleton (Step 4). Additional BOA services include exception generation and object reference management (Step 5).

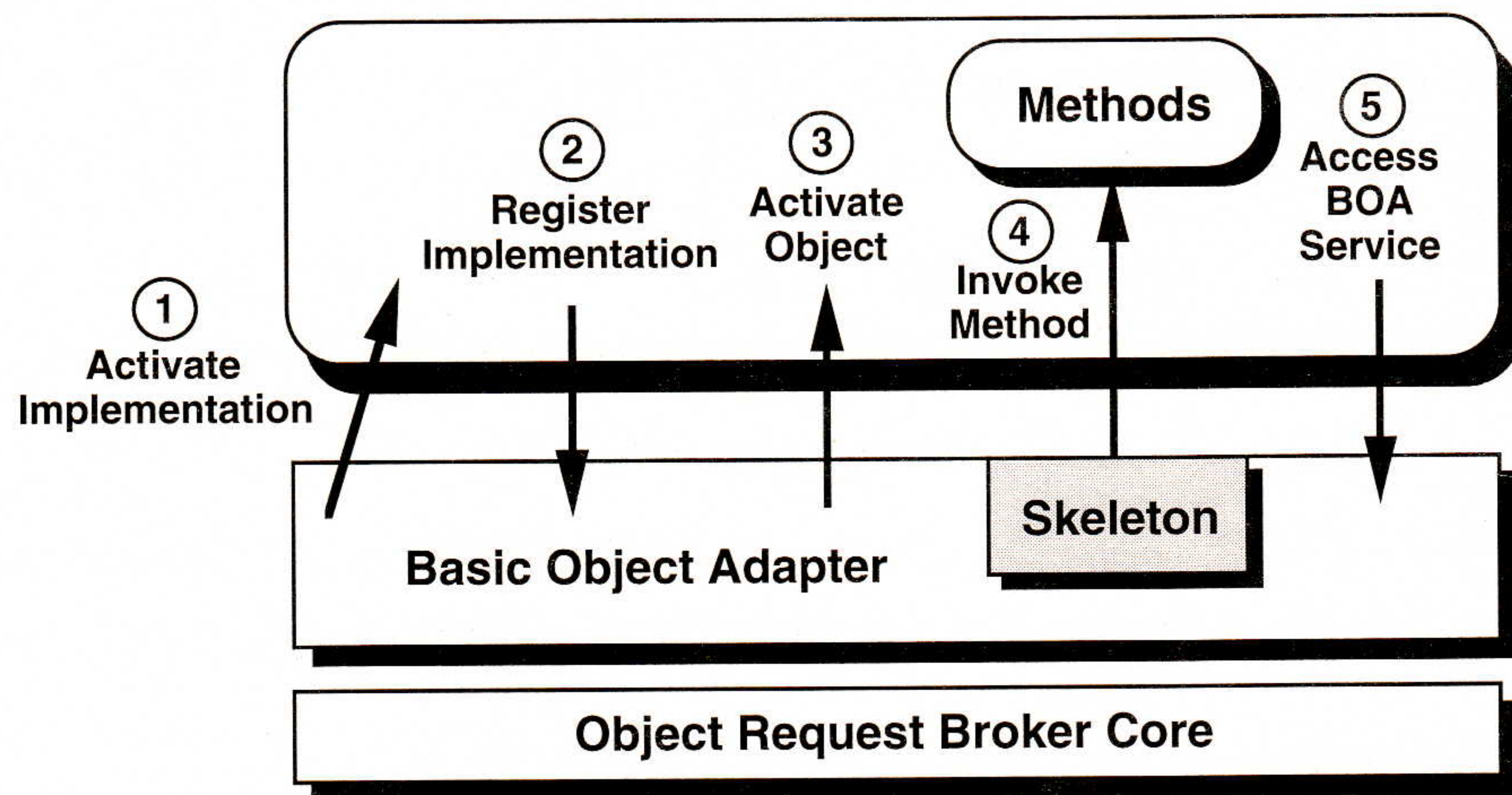


Figure 3. Basic Object Adapter

Object Services

Object services comprise a base set of OMG IDL specifications. Whereas, CORBA addresses the distributed communication facility; object services address the need for interface standards supporting application-level interoperability. The OMG's standardized services are incorporated in the *Common Object Services Specification* (COSS) [7]. Currently, this set includes the *Naming Service*, the *Event Service*, and the *Life Cycle Service*. The OMG has released a schedule for the adoption of additional object services [3].

The COSS Naming Service binds a name to an object within a given naming context [7]. Clients may query the naming service to retrieve object handles. When a name is resolved, the object associated with the name is determined. Names may be compound values, such as Internet or *Distributed Computing Environment* (DCE) addresses. The naming service does not assign or interpret the name component attributes, thus allowing software at higher levels to determine policies and management of the values.

The COSS Event Service is an extensible facility supporting multiple event models and qualities of service in a distributed environment [7]. While normal CORBA requests are synchronous, an object called an *event channel* allows multiple consumers and suppliers of events to communicate asynchronously. Polled and blocking event notification styles are supported for both event suppliers and event consumers. Event channels may support all styles simultaneously in order to match the interaction styles of different applications.

The COSS Life Cycle Service addresses fundamental management operations: how to create, copy, move, and remove objects [7]. The specification defines the concept of a user-supplied object factory which provides application-specific object creation services.

CORBA (*continued*)

The generic factory service interface provides a sample object creation operation. The factory finder interface defines a way to locate factory objects. Other Life Cycle operations including copy, move, and remove are supported directly by application objects. A future service, *Object Relationships*, will extend the Life Cycle Service with operations upon groups of distributed objects.

CORBA acceptance

CORBA and OMG IDL have gained wide acceptance across industry and consortia. OMG membership now exceeds 340 organizations, including virtually all platform manufacturers and major independent software vendors. It should be noted that the OMG does not have a competing standards organization, and it is collaborating with formal standards bodies such as ISO and ANSI. This allows the OMG to produce standards quickly and effectively. X/Open co-publishes the CORBA specification and has included CORBA in the *X/Open Portability Guide Release 4*. The Open Software Foundation (OSF) is using CORBA as the central infrastructure for the *Distributed Management Environment* (DCE). Similarly, UNIX International has included CORBA in their UI-ATLAS architecture. UI-ATLAS is the goal architecture for UNIX System V. UI-ATLAS uses CORBA in two ways: as an object management facility and as a common interface language across RPC standards. OMG IDL is the specification language for the *Fresco* library in the next release of X Windows, X11R6. *Fresco* gains portability from OMG IDL's language independence. CORBA is also a baseline standard for the Petroleum Open Systems Consortium and the Open Geographic Information System (GIS) Foundation.

CORBA acceptance in the U.S. government is growing rapidly [4]. The Department of Defense (DoD)'s Defense Information Systems Agency (DISA) and the MITRE Corporation have joined the OMG. CORBA is included in several government standards profiles. A *Federal Information Processing Standard* (FIPS) for CORBA and a standard *Ada* mapping to OMG IDL are in preparation.

Product availability

Several vendors are already delivering productized CORBA implementations including: Digital Equipment (DEC), Hewlett Packard (HP), *HyperDesk*, IBM and IONA. Available CORBA implementations cover most operating systems including: Solaris, OS/2, AIX, HP-UX, DG/UX, VMS, OSF/1, IRIX, Macintosh, Windows, and Windows-NT. Apple has announced future support for CORBA in their VITAL architecture. Microsoft has not publicly committed to support CORBA, but they are developing an ORB-like operating system, CAIRO, which is likely to provide CORBA support. Several ORB vendors already have CORBA interfaces to Microsoft's DDE and OLE. Third party vendors, such as Integrated Computer Solutions, Oberon, Tivoli, and Paragon Imaging have announced CORBA compliant application-level products. In addition, CORBA vendors are producing commercial database interfaces.

COSE and ToolTalk

CORBA is a future standard of the *Common Open Software Environment* (COSE), an industry alliance of companies including DEC, HP, IBM, Novell, Santa Cruz Operation (SCO), SunSoft, and others. These vendors have committed to deliver CORBA compliant products. COSE has selected *ToolTalk* as their initial application integration solution. *ToolTalk* extends RPC facilities with an embedded event notification mechanism that predates CORBA. For upwards compatibility, SunSoft will support *ToolTalk* interfaces in its future CORBA offering [5]. *ToolTalk* was selected by COSE because it is a mature technology today, but virtually everyone acknowledges that *ToolTalk* is a transitional technology that CORBA will supplant.

ORB interoperability

CORBA is an abstract specification that does not constrain its underlying implementation. The ORB can be implemented as a linked library, a layer directly over RPC, or as a higher-level communication facility. This flexibility allows vendors to utilize existing networking facilities. Some vendors are basing CORBA upon RPC (such as HP and HyperDesk) and other vendors are implementing CORBA over the transport layer (such as SunSoft and DEC). Most vendors also support a built-in library function interface, so that object implementations may be linked directly with client programs.

The CORBA technology of today is analogous to the early days of Ethernet; the vendors are building to a common standard, but their products cannot yet interoperate. If you want to build a multi-platform ORB application today, you need to choose an ORB product that runs on all the target machines. Luckily, most current ORB products run across multiple operating systems. In the future, when CORBA products are bundled with operating systems, the CORBA 2.0 standard will enable multi-vendor ORB implementations to interoperate transparently. SunSoft, HP, and IBM have announced plans to support ORB interoperability. At the recent CORBA Developer's Workshop, we noted that the ORB developers were highly motivated to resolve the ORB interoperability issue successfully.

Conclusions

ORB technology is a rapidly emerging area. Several CORBA products are available today, and platform vendors are putting substantial investments into bundled CORBA-compliant operating systems. At a minimum, CORBA will be a pervasive facility in the UNIX market with bundled implementations of CORBA on most platforms. Third parties already provide ORB products on the remaining major operating systems, and prospects are excellent for universal support of CORBA.

Getting started

There are many ways to prepare for your organization's technology transition to CORBA. The OMG has published the *Object Management Architecture Guide* and the CORBA Specification [1] [2]. These publications are available in computer bookstores. The OMG's Internet address for information requests is omg_request@omg.org, and their fax information line is 1-800-486-9808. Most ORB vendors offer comprehensive training courses covering their CORBA products. The courses offer insight into the standard and the technology. Notes from the OMG CORBA session at INTEROP 93 August are available describing the authors' CORBA development experiences [6].

OMG IDL is a stable language that can be used today for specifying application architectures. A public domain OMG IDL compiler toolkit is available from the OMG (via anonymous FTP from omg.org); the toolkit readily supports OMG IDL syntax checking, and the toolkit can be extended for additional applications of OMG IDL. The greatest benefits can be realized when OMG IDL is used to define reusable architectures and services. This allows organizations to leverage software development between projects and it simplifies the upgrade of distributed software systems.

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Object Management,
ORB,
Object Request Broker,
OMG IDL,
and CORBA

TRnet: A Possible Future Use of the Internet

by Billy Barron, University of Texas

Overview

The library profession is suffering from a severe funding problem. Libraries are getting less funding than ever while materials are costing more than ever. Most libraries are reducing services and/or new materials. At the same time, much work is being done by the Internet community on electronic books and journals as well as document delivery systems such as *Gopher* and *WorldWideWeb*. However, up till now, they have just supplemented libraries.

TeleRead

David Rothman, author of several microcomputing books, has put together a rather interesting proposal to address these problems. It's known as *TeleRead* and currently is being considered by some parts of the US Government. TeleRead also address such issues as copyright and electronic publishing. It is a US plan, but can easily be adopted to foreign countries.

TeleRead suggests that electronic books should be used to solve these problems of libraries. First of all, the proposal believes that laptops are now reaching the screen resolution necessary for electronic books to be readable. With recent announcements I have seen, this appears to be true.

Rothman also suggests that TeleRead be used for electronic submission of forms to the government. This should save the government quite a bit of money by eliminating the manual processing and data entry of documents (especially tax returns). Estimates have placed this figure in the tens of billions of dollars, both in terms of time and money saved on government-created paperwork. In fact, the proposal suggests that TeleRead can be funded from these savings.

Ties with the Internet

The distribution system would be known as *TRnet*. TRnet might exist directly on the Internet or be run in parallel. The benefits of having TRnet use the Internet as a transport would be many. First of all, the avoidance of having two independently managed networks would save money. Another cost saver would be the normal economies of scale. The Internet would allow TRnet to easily become multinational in scope if other governments adopted the concept. TRnet could drive improvements in Internet technology and vice versa.

TRnet would require increased federal funding in networking. Even though the US government is getting out of the direct funding of the NSFNET, no conflict exists. TRnet can bid the needed networking services from the commercial vendors. A contract with the potential size of TRnet should encourage vendors to be competitive, which may also help reduce the cost of Internet services to the rest of us. One parallel, in the funding sense, is that though the NSF is getting out of the direct network funding, they will continue supporting their supercomputing facilities. TRnet could be a similar project by the Department of Education or some other branch of the government. Both have some similar features such as using distributed computing sites.

Obviously, allowing access to TRnet by everyone is a drastic, but expected change from the current Internet. The security on TRnet must be of a higher level than the current state of Internet security. Some of the issues include: Are passwords sufficient? If not, are smart cards easy enough for people to use while being cost effective? Will the current *Privacy Enhanced Mail* (PEM) work be sufficient to scale adequately to this number of users and be easy enough to use? All of these questions will need to be answered.

continued on next page

**Electronic publications
on the Internet****A Possible Future Use of the Internet (*continued*)**

I cannot point to a particular electronic publication and claim that it is the first that was on the Internet. It is safe to say that the earliest publications I have seen were from the early 1980s. Ever since then, we have been on an exponential growth curve.

Definitely, one of the earliest and most famous projects is *Project Gutenberg* run by Michael Hart. Project Gutenberg has been taking public domain books and digitizing them. The plan is for this to grow at an exponential rate.

On the commercial side of the fence, one of the most interesting projects has been the *Online Book Initiative* (OBI). For example, OBI has been making Tracy LaQuey's *The Internet Companion* available one chapter at a time gradually over the Internet.

Going away from books to periodicals we find well over 500 free electronic publications available on the Internet and probably another 50–100 for pay publications out there. CICNet maintains the largest collection of these materials anywhere on the Internet.

These are just some samples of the work being done with electronic publications in the Internet community. It is definitely a booming market especially since tools like *Gopher* and *WorldWideWeb* have come along.

User access to TRnet

Access to TRnet would be free or be available at a modest flat rate and access for poor people would be free under any case. The reason for this is that TRnet should be considered as a public library type of service. A good part of the funding for TRnet would go into the development of inexpensive laptop computers for the poor. These laptops would be designed for maximum usability with TeleRead though they could do other things as well. I think the benefits of this focus will allow them to be better bookreaders than anything we currently have. The problems of hooking portable computers into the Net have definitely been conquered.

Publishing on TRnet

TRnet would carry all new books and other materials. Also, authors and publishers could make existing books available for reach by this large market. The proposal suggests that all materials longer than 10,000 words would eventually have to be in digital form on TRnet for the government to grant a copyright on it. Many copyright issues are covered, including protection of unpublished manuscripts. On many newsgroups, numerous arguments regarding copyrights on electronic materials have broken out. Also, many copyright experts have agreed that the copyright system is in bad need of revision due to electronic publishing. The proposal even suggests a new system for the interaction between authors and publishers. One part of this is a new author payment system.

Where do librarians fit into the picture? They would be responsible for developing and managing the collections available on TRnet. Even bookstores have their role in this proposal in providing additional access to materials, both electronic and hardcopy.

TRnet can also be used as a software distribution channel. At the time of writing, the Internet software distribution channel appears to be heading towards a potentially dark time. The Army appears to be retiring the software archive host "Simtel-20" and Keith Peterson along with it. The TeleRead proposal would allow people like Keith to continue to be paid for this kind of work. As we all know, the Internet is only as good as the resources available on it.

Conclusion

If you are interested in seeing the actual proposal, it is available for anonymous FTP on Internet host `ftp.utdallas.edu` in the file `/pub/staff/billy/teleread.doc` and on host `ftp.cic.net` as `/pub/e-serials/related/teleread.doc`. Via *Gopher* it can be found on `gopher.cic.net` in "Electronic Serials/Related Materials." Also, feel free to contact David Rothman directly via e-mail at `drothman@digex.net` with any comments.

Even if TeleRead is not accepted by the US Government, we will see some type of electronic book publishing on the Net eventually. It will be one of the many interesting services available in the future.

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BILLY BARRON has an M.S. in Computer Science from the University of North Texas. He also worked there for many years until he recently transferred to the University of Texas at Dallas. In parallel, he has worked on the CICNet Electronic Journal Archive, but recently resigned to have more free time. Also, he has the co-author of a famous guide to libraries on the Internet. Somehow, without meaning to, his last *ConneXions* article, "The Message Send Protocol" started a very heated discussion on a BIT-NET related mailing list. Finally, he recently became engaged to another experienced Internet user. E-mail: `billy@utdallas.edu`

Call for Papers

Background

The IEEE *Journal on Selected Areas in Communications* (JSAC) plans to publish a special issue on *The Global Internet* in 1995. The Internet has grown from the dozen or so nodes of the original ARPANET to a collection of more than 15,000 autonomous networks with around 2,000,000 hosts in 60+ countries, forming the largest data network ever in existence. Its exponential growth and status as a component of the U.S. *National Information Infrastructure* have significantly enhanced interest in the Internet in the past few years. It also uniquely combines operational networks which large numbers of educational, research and commercial users depend on with an experimental network conducive to the rapid introduction of new services. Internet technology has found widespread use even in networks not physically connected to the Internet itself. In both organization and technical details, the Internet marks a departure from customary telecommunications and data networks, even though the underlying transmission technology is often similar. Many of the issues faced by the Internet today—in particular scaling, heterogeneity, security over untrusted links and integrated services—will confront both private and public (data) networks in the near future.

Topics

Technical papers are solicited concerning key Internet problems including the following:

- Scaling and heterogeneity
- Novel applications for the Internet
- Routing, addressing and naming
- Support for mobility
- Integration of new technologies such as ATM, SMDS, Frame Relay and large public data networks with the Internet
- Information Services and Resource Discovery
- Large-scale multicast
- Internet multimedia, such as real-time audio/video conferencing, signaling issues
- Quality-of-Service issues in an internet
- Resource accounting and billing
- Privacy and security in internetworks

Submissions

Electronic submissions in *PostScript*, *LaTeX* or *HTML* formats are encouraged. Please contact Henning Schulzrinne by electronic mail for requirements. Submissions should be sent to Deborah Estrin only according to the following schedule:

Important dates

Manuscript submission: February 1, 1994
Acceptance notification: June 1994
Final manuscript due: August 1994
Publication date: 1st Quarter 1995

Guest Editors

Jon Crowcroft, University College London: J.Crowcroft@cs.ucl.ac.uk
Deborah Estrin, University of Southern California: estrin@usc.edu
Henning Schulzrinne, AT&T Bell Laboratories: hgs@research.att.com
Michael Schwartz, University of Colorado: schwartz@cs.colorado.edu

Call for Participation

The USENIX *UNIX Applications Development Symposium* will be held April 25–28, 1994 at the Marriott Hotel in Toronto, Ontario; Canada. The symposium is co-sponsored by the USENIX Association and UniForum Canada.

Introduction

One of the major uses of UNIX is the support, development, and execution of applications which ultimately serve as tools for end-users. In addition, the current trend of downsizing major applications from monolithic data-center environments to less expensive, distributed workstations and client-server computing environments affords UNIX a serious position in the commercial marketplace. Because UNIX has become a viable commercial alternative, developers are now porting and developing code for scientific and business applications which in the past have been the province of contributed code. Consequently, more and more computing and information systems professionals are encountering UNIX when developing and maintaining applications.

Goals

The purpose of the UNIX Applications Development Symposium is to expose the challenges of building and maintaining applications on UNIX platforms, to discuss solutions and experiences, and to explore existing practice and technique. Computing professionals who have long viewed UNIX as the program development platform of choice, as well as professionals new to the UNIX environment, will learn of helpful tools, novel approaches, and what *not* to do when developing for or porting an application to the UNIX environment.

The symposium will feature technical papers, invited talks, panel discussions, and tutorials on all aspects of designing, building, testing, debugging, reproducing, and maintaining applications within and for the UNIX environment. There will be ample opportunity to meet your peers and make contact with others with similar interests.

The UNIX Applications Development Symposium will provide valuable information to designers, programmers, and managers who plan to port existing applications into the UNIX environment or move development and maintenance teams from various proprietary environments to UNIX.

Tutorial program

The two, day-long tutorials are targeted to programmers and managers interested in developing applications in, and products for, the UNIX environment. Each is led by an experienced instructor who is an expert in his topic. The Monday tutorial by Richard Stevens covers the use of the UNIX environment to develop applications. The tutorial on Tuesday, presented by Rob Kolstad, covers design and implementation issues regarding effective use by an application of the UNIX environment.

Invited talks and panel sessions

As part of the technical sessions, invited talks provide introductory and advanced information about a variety of interesting topics, such as using standard UNIX tools and employing specialized applications. We welcome suggestions for topics, as well as request proposals for particular talks. You are encouraged to direct a proposal to the program chair. State a main focus, include an outline, and emphasize why your topic is of general interest.

Panel sessions on technical issues are welcome. Persons interested in participating in panel discussions should also contact the program chair.

Call for Participation (*continued*)

WIPs

Works-In-Progress (WIP) reports provide researchers, developers, and implementors with ten minutes to speak on current work and receive valuable feedback. Present your interim results, novel approaches, or newly-completed work. Schedule your report in advance or on-site. Inquiries about WIPs should be directed to the program chair.

Suggested topics

- *Graphical User Interfaces*: The X Window System. User Interface Design and Standards. Open Look, Motif, and NeWS. Style guides and toolkits. Importance of consistency and ease of use.
- *Porting Issues*: Issues surrounding the tasks of porting an existing application to UNIX, as well as issues of making UNIX applications portable to other architectures and other platforms. POSIX compliance.
- *Networking*: Client-Server design issues. How and where to separate the functions of clients and servers. Novel paradigms. The impact of mobile computing on application design and testing. The impact of network design or selection on application development and performance.
- *CASE and Project Management*: Using UNIX tools and environment to support code development and project management. Notable gains and losses. Modifications and adaptations to well-known techniques.
- *Operating System Issues*: Adapting to limitations or benefits of various hardware platforms and operating systems. POSIX and COSE.
- *Security*: The impact of security features. Schemes for maintaining security within an application. Client-server issues. Encryption schemes. Issues affecting integrity, reliability, and non-repudiation. Using Kerberos and other third-party systems in applications.
- *Transaction Processing*: Implementing distributed transaction processing for UNIX applications. Performance and scaling issues.
- *Distributed Applications*: How do you make the best use of existing UNIX functionality to build UNIX applications? Novel solutions. Client/server considerations.
- *Object Oriented Programming*: Productivity, languages, techniques, case studies. Experiences using C++, Eiffel, or other languages in code development.
- *Internetworking*: Effects on application design and support. Interesting or useful development platforms. Portability issues. Appropriate use. Advantages and disadvantages of various network architectures.
- *Delivering and Installing Applications*: Best methods. Superuser requirements. Licenses and license administration. Software piracy. Preventing worms and viruses. How to do updates effectively, economically, and securely.
- *Testing and Certification*: The impact of compliance. Experiences coding for and meeting compliance with various standards. Applications and POSIX.1 Conformance Testing.
- *Application Standards*: What are ABI, API, and ANDF? Selection criteria and impact on application design and development.

Program Committee

Jim Duncan, Pennsylvania State University, Program Chair
 Greg Woods, GAW Consulting, Program Vice Chair
 Dan Heller, Z-Code Software, Inc.
 Rob Kolstad, Berkeley Software Design, Inc.
 Evan Leibovitch, Sound Software
 Peter Renzland, Ontario Government
 Dan Tomlinson, Compusoft
 Elizabeth Zwicky, SRI International, Inc.

Submission guidelines

Papers may feature real-life experiences, as well as research topics. Both case-study and technical papers will be accepted. Case studies should describe existing systems and include implementation details; performance data is strongly encouraged.

A submission must be in the form of an extended abstract (1500–2500 words, 3–5 pages in length). The extended abstract should represent your paper in short form. It should demonstrate that you have a real project, that you are familiar with the work in your area, and that you can clearly explain yourself.

Papers will be judged on technical merit, relevance to the theme, and suitability for presentation. Software and hardware vendors who wish to share their experiences, innovative solutions, and techniques are encouraged to submit papers.

Please submit one copy of an extended abstract (e-mail preferred) to:

Jim Duncan
USENIX App Dev 94
 Math Department
 Pennsylvania State University
 218 McAllister Building
 University Park PA USA 16802
 E-mail: app-dev-sub@math.psu.edu
 Fax: +1 814 865 3735 to Jim Duncan re: USENIX App Dev 94

Please refer to “USENIX App Dev 94” on all faxes and postal mail regarding the symposium. Please direct inquiries regarding the symposium to jim@math.psu.edu.

Important dates

Extended abstracts due:	January 11, 1994
Notifications to authors:	January 26, 1994
Final papers due:	March 11, 1994

Registration information

Materials containing all details of the technical and tutorial programs, conference registration, and hotel and airline discounts and reservation information will be mailed in mid-February 1994. If you wish to receive the registration materials, please contact:

USENIX Conference Office
 22672 Lambert St., Suite 613
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 USA
 Phone: +1 714 588 8649
 Fax: +1 714 588 9706
 E-mail: conference@usenix.org

Call for Papers

The ACM *SIGCOMM '94 Conference on Communications Architectures, Protocols and Applications* will be held at University College London in London, England from August 31 to September 2, 1994. (Tutorials and Workshop will be held on August 30).

SIGCOMM is an international forum on communication network applications and technologies, architectures, protocols, and algorithms. It is a single-track, highly selective conference where successful submissions typically report results firmly substantiated by experiment, implementation, simulation, or mathematical analysis.

Topics

Authors are invited to submit full papers concerned with both theory and practice. The areas of interest include, but are not limited to:

- Analysis and design of computer network architectures and algorithms,
- Innovative results in local area networks,
- Mixed-media networks,
- High-speed networks, routing and addressing, support for mobile hosts,
- Resource sharing in distributed systems,
- Network management,
- Distributed operating systems and databases,
- Protocol specification, verification, and analysis.

Submissions

Papers must be less than 20 double-spaced pages long, have an abstract of 100–150 words, and be original material that has not been previously published or be currently under review with another conference or journal.

All submitted papers will be judged based on their quality and relevance through double-blind reviewing where the identities of the authors are withheld from the reviewers. Authors names should not appear on the paper. A cover letter is required that identifies the paper title and lists the name, affiliation, telephone number, e-mail, and fax number of all authors.

Authors of accepted papers need to sign an ACM copyright release form. The Proceedings will be published as a special issue of ACM *SIGCOMM Computer Communication Review*. The program committee will also select a few papers for possible publication in the *IEEE/ACM Transactions on Networking*.

Submissions from North America should be sent to Craig Partridge. All other submissions should be sent to Steve Pink. Five copies are required for paper submissions. Electronic submissions (uuencoded, compressed *PostScript*) should be sent to each program chair. Authors should also e-mail the title, author names and abstract of their paper to each program chair and identify any special equipment that will be required during its presentation.

Student Paper Award

Papers submitted by students will enter a student-paper award contest. Among the accepted papers, a maximum of four outstanding papers will be awarded full conference registration and a travel grant of \$500 US dollars. To be eligible the student must be the sole author, or the first author and primary contributor. A cover letter must identify the paper as a candidate for this competition.

Important dates	Deadline for paper submissions:	1 February 1994
	Deadline for tutorial proposals:	1 March 1994
	Notification of acceptance:	2 May 1994
	Camera ready papers due:	9 June 1994

Due to the high number of anticipated submissions, authors are encouraged to strictly adhere to the submission date. For more information about the conference, contact Patrick Dowd (see below).

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Call for Papers

The 19th Annual *Conference on Local Computer Networks* (LCN), will be held October 2–5, 1994 in Minneapolis, Minnesota, USA. The event is sponsored by the IEEE Computer Society Technical Committee on Computer Communications.

Theme

The emphasis on this year's conference is on practical experience using local computer networks. This unique approach simulates a workshop environment and allows for an effective interchange among users, researchers, and vendors. Some of the primary goals of the conference are to enable those involved in the local computer network field to share experiences, lessons learned, and prototype data and analysis. Because of these objectives, papers based on experience are especially solicited. The focus of the 19th LCN will be Interconnection and Extension of Applications and Services Beyond the LAN. Papers that cover these areas are explicitly sought and will be given preference.

Information for authors

All authors must submit 5 full copies of the full technical paper by mail or delivery service. *Do not submit complete papers by fax!* The first page must contain: title of the paper, author's names including affiliations, complete mailing address, telephone and fax numbers, Internet or BITNET address, and a 250 word (maximum) abstract (double-spaced) in English to Gary Kessler, Program Chair, at the address below.

Topics

Sessions are being organized on:

- Internetworking/Routers/Bridges
- Multimedia
- Distributed Applications
- Wide Area Networks
- ATM
- Fibre Channel Networking
- High Speed Networks
- Error Control Techniques
- Congestion Control
- Metropolitan Area Networks
- Realtime Networks
- FDDI and FDDI-II
- Emerging Technologies
- Wireless Networks
- Remote Monitoring
- Network Management
- Standards
- LAN/MAN/WAN Integration
- High Performance Protocols

Submissions

Send papers to:

Gary C. Kessler, Program Chair
Hill Associates
17 Roosevelt Highway
Colchester, VT 05446 USA
Phone: +1 802-655-0940 (main office)
Phone: +1 802-655-8633 (direct)
Fax: +1 802-655-7974
E-mail: kumquat@smcvax.smcvt.edu
kumquat@smcvax.bitnet

Important dates

Date for paper submission: March 7, 1994
Notification of acceptance: June 20, 1994
Camera-Ready Copy due: July 20, 1994

Workshop on Very High Speed Networks

The Maryland Center for Telecommunications Research (MCTR) and Department of Computer Science at the University of Maryland Baltimore County (UMBC) in collaboration with the University of Maryland Institute for Advanced Computer Studies (UMIACS) at College Park will hold the *5th Maryland Workshop on Very High Speed Networks* on March 14–16, 1994 at the UMBC campus. The Workshop will be held in Lecture Hall 5 of the new Engineering and Computer Science (ECS) Building on the UMBC Campus.

Goal The goal of the workshop is to bring together experts in related areas to discuss progress and research issues in the design and implementation of very high speed communication networks. Each of the previous workshops attracted approximately 170 researchers representing academia, industry and government. The three day meeting will include invited speakers and contributed presentations. Papers on selected presentations will appear in a special issue of the *Journal of High Speed Networks*.

More information For questions regarding the technical content of the workshop or giving a presentation, please contact the workshop organizer:

Professor Deepinder Sidhu
Maryland Center for Telecommunications Research
University of Maryland – BC
Baltimore, MD 21228-5398
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<i>NetWorld+Interop 94, Atlanta, Georgia:</i>	<i>September 12–16, 1994</i>
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